REPORT

OF THE

FIFTH INTERNATIONAL OPHTHALMOLOGICAL CONGRESS

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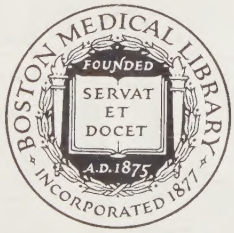

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REPORT

OF THE

Fifth International Ophthalmological Congress,

HELD IN NEW YORK, SEPTEMBER, 1876.

PUBLISHED BY A COMMITTEE COMPOSED OF

HERMANN KNAPP, HENRY D. NOYES, CHARLES S. BULL,
AND RICHARD H. DERBY.

BOSTON

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FIFTH INTERNATIONAL

OPHTHALMOLOGICAL CONGRESS,

HELD IN

NEW YORK, SEPTEMBER 12, 13, *AND* 14, 1876.

RULES.

I. The object of the International Periodic Congress of Ophthalmology is, to promote Ophthalmological Science, and to serve as a centre to those who cultivate it. It will entertain no discussion foreign to this object.

II. The number of members is unlimited.

III. Every member must either be a doctor of medicine, or of surgery, or of science, or possess some other equivalent degree, or be distinguished for his scientific knowledge.

IV. Candidates for admission into the Society shall be admitted on presentation of their diploma, or of their scientific titles, unless ten members demand a ballot.

V. The Sessions of the Society shall take place every fourth year, and shall be limited to ten days.

VI. Each Session shall be held in a different town.

VII. Before the close of each Session the Society shall fix the place for the next meeting, and shall nominate a provisional committee at this place, which shall be invested with absolute power for the direction and arrangement of all necessary business. This power will expire on the opening of the following Session.

VIII. The bureau shall be composed of a President, two

Vice-Presidents, of a Secretary-Treasurer, who shall fill at the same time the office of Archivist, and of an Assistant-Secretary, who shall aid the latter in his work, and take his place when he may happen to be absent. Of the members of the bureau, the Secretary ought to live in the town selected for the meeting of the Society.

IX. The President shall direct the debates and maintain order at the meetings. With the assistance of the other members of the bureau he shall regulate the hours of meeting, determine the order of the day, and call for the papers. The minutes of the meeting shall be signed by the President and Secretary alone.

X. The Secretary shall enter the minutes and the correspondence, shall read them, distribute the cards, and receive the subscription, which is fixed provisionally at ten francs per Session.

XI. The Society gives no diplomas. Before the opening of each Session, a card available for admission to all the meetings, and signed by the President and Secretary, shall be given to each member on payment of his subscription, and upon signature of his name on the register of those attending the meeting.

XII. The Society shall form no collections nor library. All objects presented to the Society by its members shall be returned to them at the end of the Session. The memoirs and observations intended to be inserted in the *Comptes Rendus* of the Society are excepted, and these are to be deposited in the archives with the minutes of the meetings, the decisions of the Society, and the correspondence.

XIII. The archives and the funds of the Society shall be intrusted to the Secretary, who at the close of each Session shall transmit them to the Secretary of the next Session.

XIV. A printed copy of the minutes and the other publications of the Society shall be sent to each member.

XV. The decisions of the Society shall be taken by show of hands, unless the ballot be demanded by ten members.

XVI. Decisions regularly taken during any Session are obligatory for all the members of the Society, whether present at, or absent from, the deliberation.

XVII. The business of each Session shall be carried on in the following order:

1. The reading by the Secretary of the minutes of the preceding Session.
2. Presentation of papers offered.
3. Reading of correspondence.
4. Reading of the reports presented to the Society, and nomination of commissions.
5. Verbal communications.
6. Reading of papers.
7. Determination of the order of the day for the next meeting, and several copies of this order of the day shall be put up in the place of meeting by the bureau.

XVIII. No paper may last longer than a quarter of an hour, and only five minutes is allowed to each speaker, except in particular cases where the Society thinks proper to accord longer time.

XIX. The Society shall decide in each case whether the communication shall be printed in the *Comptes Rendus* as a whole, or in the form of abstract.

LIST OF MEMBERS.

Those marked with an * attended the meetings held in New York, September, 1876.

AUSTRALIA.

Gosse (C.).....Adelaide.

AUSTRIA.

Arlt.....Vienna.
Becker (O.).....Heidelberg.
Brettauer.....Trieste.
Gulz.....Vienna.
Hasner von Artha.....Prague.
Jaeger (Ed.).....Vienna.
Kauka.....Presburg.
Meyer (Ignaz).....Vienna.
Pilz (J.).....Prague.
Stellwag von Carion.....Vienna.
Schulek.....Pesth.
Vladesco.....Bucharest.

BELGIUM.

Binard.....Mons.
Borlée.....Liége.
Bosteels.....Anvers.
Bribosia.....Namur.
Coppez.....Brussels.
Crocq..... "
Dastol.....Mons.
*Debaissieux.....Louvain.
Decaisne.....Brussels.
Deronbaix..... "
Duwez..... "
Feigneaux (A.)..... "
Gonzée.....Anvers.
Gustin.....St.-Nicolas.
Hairion.....Louvain.
Libbrecht.....Ghent.
Merchie.....Brussels.
Monreau (A.).....Anvers.
Noël (L.).....Louvain.
Stiévenart, Jr.....Mons.
Thiry.....Brussels.
Vallez..... "
Van Biervliet.....Bruges.
Vleminckx (J. F.).....Brussels.
Warlomont (E.)..... "

BRAZIL.

Barbosa.....
Bustamento.....
Fonseca (A.).....Pernambuco.
Fragoso.....Rio de Janeiro.
Gouvêa..... "
Lobo Gama..... "
Pires.....Rio de Janeiro.

DENMARK.

Buntzen.....Copenhagen.
*Hansen..... "
Holmer..... "
Jacobson..... "
Neu.....Nordingborg.
Pingues.....Copenhagen.
Solfverberg..... "
Studsgaard..... "
Toft..... "

EGYPT.

ABBATTE.....Alexandria.
AGELVIE.....Cairo.
MOHAMMED-ALI-BEY..... "

FRANCE.

ANCELON.....Nancy.
ANCONA (J.).....Paris.
BLANC..... Marseilles.
BOISSONNEAU.....Paris.
BOUISSON.....Montpellier.
BOREL .....Rouen.
BOSSU (A.).....Paris.
CAUDMONT..... "
COMPÉRAT.....Seus.
CONTRELET .....Paris.
COURSSERANT..... "
DELACROIX .....Rheims.
DELAVALLADE.....Aubusson.
DEMARQUAY .....Paris.
DUCHENNE DE BOULOGNE.... "
FANO..... "
GAGNON.... ....Clermont-Ferrand.
GAILLARD.....Poitiers.
GALEZOWSKI.....Paris.
GIRALDÈS..... "
GIRAUD-TEULON ..... "
GUERIN (J.)..... "
GUILLON..... "
HERSCHEL..... "
HYETT (N. N.)..... "
JAUMES .....Montpellier.
JAVAL.....Paris.
LABROUCHE.....Bordeaux.
LAFFORRE (DE).....Paris.
LAURENT .....Angers.
LEJEUNE..... ..Paris.
MARTIN .....Marseilles.
MARTINACHE .....Paris.
MATHIEU-MILING..... "
MÉTAXAS ....Marseilles.
MEYER (ED.).....Paris.
MILON ..... "
MORPAIN..... "
NACHET ..... "
PARIS (AMÉDÉE).....Angoulême.
PARMENTIER .....Paris.
PASQUIER..... "
PICARD (A.)..... "
RAYMOND..... "
RIVAUD-LANDRAU.....Lyons.
ROUAULT.....Conesquelin.
SCHUSTER.....Paris.
SICHEL (A.)..... "
SOUS .....Bordeaux.
SAINT-VEL.....Paris.
TESTELIN.....Lille.
WECKER .....Paris.
WERTHEIMBER..... "

GERMANY.

ALEFELD.....Wiesbaden.
BARTMER.....Hanover.
BERLIN .....Stuttgart.
BRUNS.....Tübingen.
CLASSEN..... .....Rostock.
CLEMENS.....Frankenhausen.
COCCIUS.....Leipsic.
COHN.....Breslau.
DE WELZ.....Würzburg.
DURR .....Hanover.
EICHENBRODT.....Darmstadt.
ESBERG.....Hanover.
ESMARCK .....Kiel.
FÖRSTER.....Breslau.
FUNCK .....Frankfort-on-the-Main.
GEISSLER .....Meerane.
GEROLD .....Berlin.
GIESELER .....Bremerlehe.
GUTBROD .....Stuttgart.
HAASE.....Bonn.
HANEL (G.).....Dresden.
HELMHOLTZ.....Berlin.
HERNIG .....Leipsic.
HESS.....Mayence.
HOCHBERGER.....Greiz.
HOFFMANN (H. VON)....Wiesbaden.
HÖRING.....Louisburg.
JUST (O.).....Zittau.
KLAUNIG .....Leipsic.
KLOTZ.....Zwickau.
KNOWE .....Hamburg.

KRAUSE.....Göttingen.
KRAUSE.....Hamburg.
KÜCHLER.....Darmstadt.
LANGENBECK (M.).....Hanover.
LAQUEUR.....Strasburg.
LEHMANN.....Kiel.
MOOREN.....Düsseldorf.
MÜLLER.....Hanover.
NAGEL.....Tübingen.
NUSSBAUM.....Munich.
PAGENSTECHER (A.).....Wiesbaden.
PAGENSTECHER (H.) .... "
PASSAVENT..Frankfort-on-the-Main.
PRAEL, Jr.....Brunswick.
PRAEL, Sr..... "
RITTER.....Kiel.
ROTHMUND.....Munich.
SAEMISCH.....Bonn.
SCHIFF.....Frankfort.
SCHMITZ.....Cologne.
SCHRŒDERS (VON).....Leipsic.
SCHWARD..... Nienburg.
SCHWEIGGER.....Berlin.
SPIESS.....Frankfort.
STROMEYER (E.).....Hanover.
STROMEYER (L.)..... "
STURM.....Boestritz.
UHDE.....Brunswick.
ULRICH.....Salzderfurth.
UNGER.....Dresden.
VOELKERS.....Kiel.
VOGELSANG.....Hanover.
WARNATZ.....Dresden.
WEBER.....Darmstadt.
WINTER.....Leipsic.
ZANDER.....Chemnitz.
ZEHENDER..... Rostock.

GREAT BRITAIN.

ANDREW (E.).....Shrewsbury.
BADER (C.).....London.
BLACK (T.).....Edinburgh.
BOWMAN (W.).....London.
BROWN.....Glasgow.
*CARTER (R. B.).....London.
COOPER (W. W.)..... "
COOPER (JOHN).....London.
COWEL (G.)..... "
CRITCHETT (G.)..... "
CRITCHETT (G. A.)..... "
DAVIDSON (A. D.)..... "
DUDGEON (R. E.)..... "
DURREN..... "
FITZGERALD (C. E.).. .... Dublin.
FRANK.....London.
GILLOTT (F. D.).....Sheffield.
HADEN (H. W.).....London.
HANCOCK (H.)..... "
HARDY (H. N.)..... "
HOGG (J.)..... "
HOLTHOUSE (C.)..... "
HULKE (J. W.)..... "
HUTCHINSON (J.)..... "
JACKSON (J. H.)..... "
JONES (H. M.).....Cork.
KOPPEN.....London.
LAWSON (G.)..... "
LIEBREICH..... "
LITTLE (D.).....Manchester.
MACGAVIN.....Edinburgh.
MACGAVIN.....London.
*MACHARDY (M. M.)..... "
NIEDEN..... "
O'LEARY (P.).....Cork.
POWER (H.).....London.
REED (T.).....Glasgow.
*ROBERTSON (D. A.)....Edinburgh.
ROGERS (G. H.).....London.
SAMELSON (A.).....Manchester.
STREATFEILD (J. F.).....London.
TAY (W.)..... "
TAYLOR (R.)..... .... "
TEALE (T. P.)..... ....Leeds.
WALKER (A.).....London.
WALKER (J.).....Leeds.
WALKER (T. S.).....Liverpool.
WALL (T.).....Cork.
WATSON (W. S.).....London.
WELLS (J. S.)..... ... "
WILSON (A.).....Dublin.
WILSON (H.)..... "
WINDSOR (T.).....Manchester.

Wolfe (J. R.).....Glasgow.
Workman (C. J.)..... Devon.

BRITISH POSSESSIONS IN NORTH AMERICA.

*Burt (W.).....Paris, Ont.
*Buller (F.).....Montreal.
*Desjardins (L. A. E.)... "
*Dodge (S.).....Halifax.
*Proudfoot (A.).....Montreal.
*Reeve (R. A.).....Toronto.
*Rosebrugh (A. M.)..... "
*Turgeon (L. G.).....Montreal.

GREECE.

Anagnostakis.....Athens.
Röser..... "

HOLLAND.

Baart de la Faille..Leeuwarden.
Baudin.....Japon.
Blom Coster.....La Haye.
Broecke (Van den)...Middelburg.
Broers.....Utrecht.
Burg (Van den).....Batavia.
Dissel (Van).....Lochem.
Dommelen (Van).....La Haye.
Donders.....Utrecht.
Doyer.....Leyden.
Dyck (Van).....Dreumel.
Eichstorff.....Smyrna.
Eichstorff..... Brielle.
Eichstorff..... Zuylen.
Fles.....Utrecht.
*Gori.....Amsterdam.
Gunning..... "
Haan (Vroesom de)...Veenhuizen.
Haas (De).....Rotterdam.
Haerten.....Utrecht.
Haffmans.....Roermond.
Hamer.....Utrecht.
Harteveit.....Rotterdam.
Hattem (Van).....Batavia.
Hissinck-Jaussen.....Groningen.
Hoeven (Van der).....Rotterdam.
Hofman.....Veenhuizen.
Hoogenstraeten.....Batavia.
Imans.....Utrecht.
Klep.....Oosterhout.
Koster.....Utrecht.
Krieger.....Leyden.
Krol.....Utrecht.
Kroon.....Zutphen.
Lindeboom.....Zwolle.
Lissa (Van).....Middelburg.
Lulofs.....Hardinxfeld.
MacGillavry.....Java.
Moes.....Amsterdam.
Moll.....La Haye.
Onnen.....Batavia.
Oudenhoff.....Utrecht.
Reeken (Van).....Monnikendam.
Reysen (Van).....Haarlem.
Salomons.....Veenhuizen.
Sasche.....Nieuwe-Diep.
Scharff.....Oostzaan.
Schoenmaker.....Borne.
Schrant..... Leyden.
Schubaert.....Utrecht.
Snellen.....Utrecht.
Stark.....Rhenen.
Suick.....Utrecht.
Sweens.....Hertogenbosch.
Themmen.....Deventer.
Tilanus.....Amsterdam.
Vos.....Breukelen.
Wessem (Van).....Amsterdam.
Wicheren (Van).....Utrecht.
Willemier (Q.)..... "

ITALY.

Arcoleo.....Palermo.
Borelli (J. B.).....Turin.
Calderini..... "
Grosetti.....Brescia.
Magni (F.).....Bologna.
Mannhardt.....Florence.
Olivieri.....Naples.
Perillo.....Luce.
Pertile.....Padua.
Ponti Floriano.....Parma.
Quaglino.....Milan.

Reymond ..... Turin.
Secondi ..... Genoa.
Sperino (C.) ..... Turin.

MEXICO.

Iglesias ..... Mexico.

PORTUGAL.

Loureiro ..... Lisbon.
Marques ..... "
Sa Mendes ..... "

RUSSIA AND POLAND.

Berthenson ..... St. Petersburg.
Blesig ..... "
Bohdanowski ..... Moscow.
Braun ..... "
Claus ..... Ural.
Dombrowski (B) ..... "
Flowitz ..... St. Petersburg.
Froebelius ..... "
Hartmann ..... "
Hirschmann ..... Cracow.
Huebbenett (De) ..... Kiew.
Hynsag ..... St. Petersburg.
Iwanoff ..... "
Junge ..... "
Kabath (De) ..... "
Kischineff ..... "
Klien ..... Moscow.
Kronewitch ..... Poland.
Leich ..... St. Petersburg.
Lotin ..... "
Matuschenkow ..... Moscow.
Pfoehl ..... St. Petersburg.
Seydewitz (Baron von) .....
Tamanscheff ..... St. Petersburg.
Waldauer ..... Riga.
Wernicky ..... Poland.
Wilkousky ..... St. Petersburg.
Zagiell (Prince Ignace) ... Poland.

SPAIN.

Calvo y Martin ..... Madrid.
Carreras ..... Barcelona.
Cervera ..... Madrid.
Chivalt (V.) ..... Seville.
*Dudley (D. E.) ..... Manila.
Montaut ..... Madrid.
Pedraglia ..... "

SWEDEN AND NORWAY.

Asplund ..... Gothenburg.
Bjorken ..... Upsal.
Boeck ..... Christiania.
Edholm ..... Helsingfors.
*Estlander ..... "
Faye ..... Christiania.
Heiberg ..... "
*Hjort (J.) ..... "
Keyser ..... "
Lundberg ..... Stockholm.
Miloch ..... Helsingfors.
Rossander ..... Stockholm.
Thilesen ..... Christiania.
Tornblow ..... Stockholm.

SWITZERLAND.

Baenziger ..... St. Gallen.
Dor ..... Bern.
Dufour ..... Lausanne.
Horner ..... Zürich.
Moricand ..... Geneva.
Schiess ..... Basel.

TURKEY.

Agelastos ..... Constantinople.
Huebsch (De) ..... "
Sarandi ..... "

UNITED STATES.

*Abbott (F. W.) ..... Buffalo.
*Agnew (C. R.) ..... New York.
*Allin (C. M.) ..... "
*Alt (A.) ..... "
*Althof (H.) ..... "
*Bacon (W. T.) ..... Hartford.
*Barrows (B. C.) ..... Boston.
*Bartlett (E. W.) ..... Milwaukee.
*Bleything (G. D.) ..... New York.
*Blitz (A.) ..... Nashville.
*Brandeis (R. C.) ..... Louisville.

*Brown (U. H.).....Syracuse.
*Bull (C. S.).....New York.
*Burnett (S. M.).Washington, D. C.
*Calhoun (A. W.).....Atlanta.
*Callan (P. A.).....New York.
*Carmalt (W. H.)....New Haven.
*Cheatham (W.).....New York.
*Coggin (D.).....Salem.
*Cornwell (H. G.).....Brooklyn.
*Derby (R. H.).....New York.
*Dills (T. J.).....Fort Wayne.
*Dixon (L. S.).....Worcester.
*Dupuy (E.).....New York.
*Dyer (E.).....Pittsburg.
*Ely (E. T.).....New York.
*Eno (H. C.)..... "
*Fenner (C. S.).....Louisville.
*Goodman (H. E.)....Philadelphia.
*Green (J.) .....St. Louis.
*Gruening (E.).....New York.
*Hackley (C. E.).....New York.
*Hall (A. D.).....Philadelphia.
*Harlan (G. C.)..... "
*Hay (G.).....Boston.
*Hay (T.).....Philadelphia.
*Hazen (E. H.).....Davenport.
*Heitzmann (C.).....New York.
*Heyl (A. G.) .....Philadelphia.
*Hinton (J. H.) .....New York.
*Holcomb (W. F.)..... "
*Holmes (E. L.).....Chicago.
*Howe (L.).....Buffalo.
*Hunt (D.).....Boston.
*Hutchinson (E.).....Utica.
*Jeffries (B. J.)..... ...Boston.
*Jones (S. J.).....Chicago.
*Keyser (P. D.).....Philadelphia.
*Kipp (C. J.).....Newark.
*Knapp (H.) .....New York.
*Loring (E. G.).....New York.
*Loring (F. B.)..Washington, D. C.
*McFarland (S. F.).....Oxford.
*McKay (R. J.).....New York.
*Mathewson (A.).....Brooklyn.
*Merrill (C. F.).....Albany.
*Miller (H. G.).....Providence.
*Milne (J. A.).....Oswego.
*Mittendorf (W. F.)...New York.
*Munson (F. A.).....Albany.
*Noyes (H. D.).....New York.
*Noyes (J. F.).....Detroit.
*Pardee (C. J.).....New York.
*Pinkney (H.)..... "
*Pomeroy (O. D.)..... "
*Pooley (T. R.)..... "
*Prout (J. S.).....Brooklyn.
*Rankin (W.).....Newark.
*Rider (C. E.) .....Rochester.
*Risley (S. D.) .....Philadelphia.
*Robertson (C. E.).....Albany.
*Rushmore (J. D.) .....Brooklyn.
*Roosa (D. B. St. J.)...New York.
*Parker (M. G.).....Lowell.
*Scott (X. C.).....Cleveland.
*Sinclair (A. G.).....Detroit.
*Smith (D. B.) .....Cleveland.
*Smith (E.)..... Detroit.
*Sprague (F. P.).....Boston.
*St. John (S. B.).....New York.
*Strawbridge (G.)...Philadelphia.
*Thompson (J. L.)....Indianapolis.
*Thomson (W.) .....Philadelphia.
*Turnbull (C. S.).... "
*Vermyne (J. J. B.)..New Bedford.
*Wadsworth (O. F.).....Boston.
*Williams (C. H.)..... "
*Williams (E.).....Cincinnati.
*Williams (H. W.).....Boston.

REPORT OF THE PROCEEDINGS

OF THE

FIFTH INTERNATIONAL OPHTHALMOLOGICAL CONGRESS.

REPORT OF THE PROCEEDINGS

OF THE

Fifth International Ophthalmological Congress.

The Fifth International Congress of Ophthalmology was held in Chickering Hall, New York, on the 12th, 13th, and 14th of September, 1876.

Dr. C. R. Agnew, in calling the Congress to order, remarked:

"At the meeting of the International Ophthalmological Congress, held in London in 1872, the following persons were appointed a Provisional Committee, viz.: Dr. Agnew, Dr. Noyes, and Dr. Roosa, all of this city. The Provisional Committee was charged with the duty of organizing the present Congress. In conformity with the arrangements made at that time, and the duties imposed upon me as chairman of the Provisional Committee, I would call the Fifth International Congress of Ophthalmology to order.

"In conformity with a custom, and in behalf of the Provisional Committee, I would nominate Dr. E. Williams, of Cincinnati, as President of this International Congress."

Dr. Williams was unanimously elected, and was conducted to the chair by Dr. H. D. Noyes.

INTRODUCTORY ADDRESS BY THE PRESIDENT.

Gentlemen of the International Ophthalmological Congress: It gives me very great pleasure to appear here before you, not in this capacity, but as a co-worker in the sci-

ence of Ophthalmology, and to lend support to the efforts made in this department to benefit the sufferings of our fellow-men. I feel that words fail me to express the sincere appreciation of the honor which you, in your great generosity, have seen fit to confer upon me. I can only claim the prerogative, if such it be, of having worked for twenty-five years in this exclusive department of our noble science, with an eye single to its honest and fair promotion, and the benefit of my fellow-men. Again I must thank you, with very great sincerity, for the honor you have conferred upon me.

Dr. H. D. Noyes: In furtherance of the organization, I would nominate Mr. R. Brudenell Carter, of London, and Dr. Edmund Hansen, of Copenhagen, as Vice-Presidents of this Congress.

Mr. Carter and Dr. Hansen were unanimously elected.

Mr. Carter: Mr. President and gentlemen—I have on my own part, and on the part of the ophthalmologists of England, to whom I feel the honor is also paid, to thank you sincerely for the election to this important office.

Dr. Hansen: I thank you, Mr. President and gentlemen, for the honor you have done me, and I hope the duties devolving upon me will not be very important, because, owing to the deficient knowledge I have of your language, I cannot do my duty to your satisfaction. If, however, there shall be any such demand, I hope I may rely upon your indulgence.

On motion of Dr. Roosa, Dr. F. Buller, of Montreal, was made Secretary *pro tem.*

Dr. Noyes: The Provisional Committee have received the registration of the following gentlemen, who desire to become members of the Congress, and I now place their names in your hands, Mr. President, for further action on the part of the Congress.

The following gentlemen were then elected members of the Congress:

Dr. F. W. Abbott, Buffalo, New York.
Dr. C. M. Allin, New York City.
Dr. A. Alt, New York City.
Dr. H. Althof, New York City.

Dr. W. T. Bacon, Hartford, Connecticut.
Dr. B. C. Barrows, Dorchester, Massachusetts.
Dr. E. W. Bartlett, Milwaukee, Wisconsin.
Dr. A. Blitz, Nashville, Tennessee.
Dr. R. C. Brandeis, Louisville, Kentucky.
Dr. U. H. Brown, Syracuse, New York.
Dr. S. M. Burnett, Washington, D. C.
Dr. C. S. Bull, New York City.
Dr. W. Burt, Paris, Ontario.
Dr. G. D. Bleything, New York City.
Dr. A. W. Calhoun, Atlanta, Georgia.
Dr. P. A. Callan, New York City.
Dr. W. H. Carmalt, New Haven, Connecticut.
Dr. W. Cheatham, New York City.
Dr. D. Coggin, Salem, Massachusetts.
Dr. H. G. Cornwell, Brooklyn, New York.
Dr. Debaissieux, Louvain, Belgium.
Dr. R. H. Derby, New York City.
Dr. L. A. E. Desjardins, Montreal.
Dr. T. J. Dills, Fort Wayne, Indiana.
Dr. L. S. Dixon, Worcester, Massachusetts.
Dr. S. Dodge, Halifax, Nova Scotia.
Dr. D. E. Dudley, Manilla.
Dr. E. Dupuy, New York City.
Dr. E. T. Ely, New York City.
Dr. H. C. Eno, New York City.
Dr. C. S. Fenner, Louisville, Kentucky.
Dr. W. G. Gori, Amsterdam, Holland.
Dr. H. E. Goodman, Philadelphia.
Dr. E. Gruening, New York City.
Dr. C. E. Hackley, New York City.
Dr. G. C. Harlan, Philadelphia.
Dr. E. H. Hazen, Davenport, Iowa.
Dr. G. Hay, Boston.
Dr. T. Hay, Philadelphia.
Dr. A. D. Hall, Philadelphia.
Dr. J. H. Hinton, New York City.
Prof. J. Hjort, Christiania, Norway.
Dr. E. L. Holmes, Chicago, Illinois.
Dr. L. Howe, Buffalo, New York.
Dr. D. Hunt, Boston.
Dr. E. Hutchinson, Utica, New York.
Dr. C. Heitzmann, New York City.
Dr. S. J. Jones, Chicago, Illinois.
Dr. P. D. Keyser, Philadelphia.
Dr. C. J. Kipp, Newark, New Jersey.

Dr. F. B. Loring, Washington, D. C.
Dr. E. G. Loring, Jr., New York City.
Dr. S. F. McFarland, Oxford, New York.
Dr. R. J. McKay, New York City.
Mr. M. M. MacHardy, London, England.
Dr. A. Mathewson, Brooklyn, New York.
Dr. C. S. Merrill, Albany, New York.
Dr. H. G. Miller, Providence, Rhode Island.
Dr. A. J. Milne, Oswego, New York.
Dr. W. F. Mittendorf, New York City.
Dr. F. A Munson, Albany, New York
Dr. J. F. Noyes, Detroit, Michigan.
Dr. T. R. Pooley, New York City.
Dr. C. I. Pardee, New York City.
Dr. O. D. Pomeroy, New York City.
Dr. A. Proudfoot, Montreal.
Dr. J. S. Prout, Brooklyn, New York.
Dr. H. Pinkney, New York City.
Dr. M. G. Parker, Lowell, Massachusetts.
Dr. W. Rankin, Newark, New Jersey.
Dr. R. A. Reeve, Toronto.
Dr. S. D. Risley, Philadelphia.
Dr. C. A. Robertson, Albany.
Dr. A. M. Rosebrugh, Toronto.
Dr. J. D. Rushmore, Brooklyn, New York.
Dr. C. E. Rider, Rochester, New York.
Dr. X. C. Scott, Cleveland, Ohio.
Dr. A. G. Sinclair, Detroit, Michigan.
Dr. F. P. Sprague, Boston.
Dr. G. Strawbridge, Philadelphia.
Dr. E. Smith, Detroit, Michigan.
Dr. D. B. Smith, Cleveland.
Dr. S. B. St. John, New York City.
Dr. J. L. Thompson, Indianapolis, Indiana.
Dr. S. G. Turgeon, Montreal.
Dr. C. S. Turnbull, Philadelphia.
Dr. W. Thomson, Philadelphia.
Dr. J. J. B. Vermyne, New Bedford, Massachusetts.
Dr. D. Webster, New York City.
Dr. C. H. Williams, Boston.
Dr. O. F. Wadsworth, Boston.

Dr. Roosa: The Committee of Arrangements would now recommend that a permanent Secretary and Treasurer, and an Assistant Secretary, be elected, and to that end would re-

spectfully nominate Dr. C. S. Bull, of New York, for Secretary and Treasurer, and Dr. R. H. Derby, of New York, for Assistant Secretary.

These gentlemen were then duly elected as Secretary and Assistant Secretary.

Dr. Roosa: The Committee of Arrangements also propose that a Publishing Committee be elected, and would nominate Dr. H. Knapp as Chairman, and Drs. H. D. Noyes, Bull, and Derby, as associate members, all of New York.

These gentlemen were all unanimously elected.

The Congress then adjourned to meet at 3 P. M.

Tuesday, September 12, *Afternoon Session.*

The Congress was called to order by the PRESIDENT at 3 P. M., and the minutes of the morning session were read and approved.

The President announced that the next business in order was the reading of papers, and called upon Dr. H. D. Noyes.

ON THE USE OF A NASO-BUCCAL FLAP FOR BLEPHAROPLASTY, WITH TWO CASES.

BY HENRY D. NOYES, M. D., NEW YORK.

IT is perhaps hazardous to assert that the method of operating to be described is new in ophthalmic surgery, but it has certainly not secured for itself a recognized place. I find no mention of it in systematic works; but it must be supposed that cases have occurred in which surgeons have employed it without having called special attention to the subject.

The usual localities from which flaps are taken for restoration of the eyelids are the temple and outer portion of the cheek, and the vessels upon which reliance is placed for nourishing the flap are the branches of the temporal artery. Less frequently flaps are taken from the middle of the forehead as for rhinoplasty, and the nutritive vessels are the twigs which come from the cavity of the orbit at the inner and upper part. It is to the vessels of this region, in their capacity for nourishing a flap taken from the naso-buccal furrow, that I wish to call attention. The flap is formed by incisions down the side of the nose and cheek, as far as the upper lip, or to the level of the mouth, if necessary; the free end is below, the attached end or pedicle is above. In both cases reported the pedicle was narrower than the free extremity. The incisions defining

the pedicle must be made so as to include not only all the twigs which come from the orbit of the same side where the deformity exists, but to contain also some branches from the other side of the median line. The vessels coming from the orbit are terminal branches of the ophthalmic, and are more numerous than may be supposed. There are 1, the supra-orbital, which goes to the supra-orbital notch and the skin of the forehead; 2, the anterior ethmoidal sends a few twigs to the skin, and the palpebral branches, 3, superior, and 4, inferior, lie one above and the other below the tendon of the orbicularis; they are important feeders to the skin of this region; 5, the nasal branch appears above the tendon of the orbicularis and inosculates freely with the nasal and angular branches of the facial artery. The last-named vessel is the most important, by reason of its size, its situation, and its free communications with the facial. Even when, by the incisions, the blood supply of the flap can no longer be derived from its natural source through the facial, the existence of the free anastomoses prepares channels through which the supplementary circulation from above can be distributed to the lower end of the flap. Besides these resources, if the incision defining the median side of the pedicle be laid obliquely across the nose, below the naso-frontal suture, some vessels will be brought into service coming from the circulation on the opposite side of the median line. Without laying too much stress on this last-named supply, the incision should be placed as designated to increase the breadth of the pedicle and diminish the abruptness of its turn when it is finally placed in position. Another matter is important to success, viz., to keep near to the bone in the angle of the eye in dissecting up the flap. The tendon of the orbicularis is not disturbed, but above it pains must be taken to include in the thickness of the pedicle as much tissue as possible. Special care must be exercised not to carry this dissection farther up than is absolutely needful for the suitable adjustment of the flap. Every stroke of the knife at this point is aimed at the fountain of nourishment.

By taking heed to these cautions, it is possible to obtain a flap fully three inches in length, reaching down almost to the commissure of the mouth, which shall preserve its vitality

after transplantation to a degree sufficient for an extensive repair of tissue—I mean that, while at its extremity the surface of the flap may slough, its deeper and extreme part will live, and the proximal two-thirds will be unimpaired. Such was the experience of two cases which are related in detail.

The indications for this method are two-fold: 1. The repair of lesions about the inner halves of the lids; 2. The supply of material where there is no skin available for flaps either upon the forehead or temple, or outer portion of cheek. It is to the cases under the second indication that attention is called.

Case I.—Juan Grace, aged twenty-eight, painter, was burned by kerosene-oil upon the entire scalp, forehead, and right cheek. He was received at first into Bellevue Hospital, and after some months was transferred to Charity Hospital, Blackwell's Island. I saw him first after he had resided three months in this hospital, and six months after the occurrence of the accident. A large amount of repair had been accomplished—the whole scalp had been restored, and a thin growth of hair had come in. Over the forehead there was a tense and shining cicatrix, which would, however, never become fully sound, because it was so tightly stretched by the contractile tendencies of the large area of new tissue that spots of ulceration continually existed. They would partially heal, and then break out again.

The most distressing deformity was the condition of the right eye. The upper lid was pulled far up to the forehead, being not only completely everted, but dragged up so that the ciliary border was found coincident with the eyebrow. The conjunctival surface was hypertrophied with a mass of granulations and papillæ, the eyeball in a state of great irritation, the cornea moderately hazy and vascular. The lower lid had not been damaged. The cheek in front of the ear was a firm cicatrix.

The upper lid of the opposite side, the left, was partly everted, but not to a considerable degree. Patient was reduced in health by the protracted suppuration and residence in hospital, but had a reasonable amount of vigor.

To relieve the repulsive and painful condition of the right upper lid was a difficult and formidable task. None of the usual proceedings could be employed because there was no tissue in the usual localities which could be utilized. I finally decided upon trying the capabilities of the naso-buccal flap. The whole upper lid was to be restored, and a large piece of skin was needful.

The first step was to release the upper lid from its adhesions by a horizontal incision along the orbital edge and careful dissection until the superior and inferior tarsal edges could be brought together. From the inner end of the incision, which reached almost to the median line, a cut was carried down along the inner canthus upon the cheek as far down as the mouth, running obliquely downward and outward. Parallel to this another cut was made nearer the median line, which began above on the left or opposite side of the root of the nose, ran across it obliquely, and, keeping on the inside of the angular artery, passed close to the wing of the nose, and was curved outward to complete the outline of the flap by meeting the first incision. The flap, which was then dissected up, was club-shaped; its lower end was wider, and decidedly thicker than its pedicle. As much thickness was given to it as possible. The cautions before mentioned, about detaching the flap from subjacent parts at the inner angle of the orbit, were carefully observed. The piece of skin fitted well into its place, and was not subjected to any strain.

A wide gap now yawned in the face, to which attention was next given. The plan was to slide the whole cheek toward the median line. This was effected by making an incision along the inferior orbital margin almost to the ear by extending the original incisions a little farther downward toward the jaw and then dissecting up the whole cheek, using the fingers and the handle of the scalpel as much as possible. Of course, there was copious hæmorrhage, and the spectacle was sufficiently hideous. The parts were brought together without undue stretching, and the lines of junction kept secure by numerous silk sutures and pins. The pins were fine and buried deep in the skin. Without their assistance the parts could not have been held in close apposition. The last step in the proceeding was to guard against the mischief which would ensue if the flap should fail, by paring the edges of the upper and lower lids and uniting them to each other. This was done for the outer two-thirds of their length, and was intended to be useful, even if sloughing of the flap should not occur, by moulding the lids to a better form, by enabling them, after they should adhere, to resist the traction which must occur as cicatrization proceeded, and to more perfectly protect the eye.

The operation was tedious. It occupied two hours. The patient was not badly exhausted, although prostrated by loss of blood and the effects of ether.

After being put to bed, fomentations by hot water were begun, and nourishment frequently given in small quantities. To the vigilance

and fidelity of the house-surgeon, Dr. W. O. Moore, who is now the house-surgeon of the New York Eye and Ear Infirmary, the success of the case is largely to be credited. There was necrosis of the extreme end of the flap involving only the superficial part, and about two-thirds of an inch in length. The swelling of the face was consider-

able. The incision under the lower lid healed by first intention; the lower edge of the flap adhered to the skin adjacent to the tarsus, but its upper edge could only imperfectly attach itself to the thin cicatricial tissue of the forehead. Along the side of the nose there was imperfect coaptation; the lips of the wound separated, and would have retracted widely but for the restraint of the pins. The healing of the wounds occupied about six weeks. When discharged from the Chari

ty Hospital the cornea had recovered its clearness, and the eye was free from irritation. The thickened condition of the palpebral conjunctiva was not treated, but it began to show decided improvement. The adhesion of the lids to each other was not disturbed. The cicatrix under the lower eyelid was hardly noticeable, that beside the nose was more

conspicuous. The ulcers on the forehead had entirely healed under the relaxation which the introduction of the flap had procured.

In October, 1874, the photographs were taken. In the front view the outline of the flap can be distinctly seen. The distorted condition of the lid of the other eye can also be observed. The furrowed and rough surface of the skin of the right side of the face is due principally to the burn. The cicatricial tissue shows distinctly. The line of

the incision along the zygoma can also be seen, and that it reaches almost to the ear. At this period patient was disinclined to open his eyes, and he wanted me to divide the lids asunder so that they could open more freely. This I would not do, and a year after the wisdom of refusing was seen. The contraction of the skin of the forehead had drawn so much on the flap that the palpebral opening was quite as large as needful.

Diagram of the Incisions after the Upper Lid had been lowered to its Place.

Case II.—Alfred Campbell, a boy aged six years, was burned by kerosene-oil upon the face, scalp, and arms. Three months after the accident he came under my charge at the New York Eye and Ear Infirmary. This was on March 1, 1875. The ulcerations had all healed, and the upper lids had both become badly everted by contraction of the cicatrices on the forehead. The upper lid of the right eye was most deformed, and was turned completely inside out. The conjunctiva was greatly thickened. The corneæ were both clear. The eyes did not show a great amount of irritation. An attempt had been made to correct the deformity of the right eye by simply dissecting down the lid, but this had of necessity been entirely futile.

On March 1, 1875, I performed an operation similar to that described in the previous case, and consisting of the following steps: 1.

Loosening the lid and bringing it down to its level; 2. Taking the flap, two and a half inches long, from the naso-buccal furrow—its greatest width was one inch, its width at pedicle three-quarters of an inch—then retaining this in position by sutures; 3. Dissecting up the cheek and crowding it toward the median line to fill up the vacancy. The tissues were so elastic that the incisions did not need to be so extensive to bring the wounds together as in the former case. Sutures and pins were freely used to support and retain the parts.

The operation was done under ether, and lasted two hours. The length of the incision at the situation from which the flap was taken was three and a half inches, extending from the inner canthus downward. The incision along the lower edge of the orbit outward was three and a half inches in length. The parts all came together easily, and there was no strain upon the stitches. The loss of blood was considerable, and the shock of the operation severe. Stimulants administered.

Within twenty-four hours oozing from small vessels took place under the flap, apparently because the blood had lost its coagulability in consequence of the patient's reduced condition. This caused the outer three-fourths of the flap to slough.

On the fourth day after the operation a mild attack of pneumonia occurred in both lungs.

On the twelfth day the pneumonia had resolved, and the wounds were granulating well.

By the 24th it was evident that if left to itself the deformity for which the operation was made would be fully reëstablished. The pedicle, comprising about one-fourth of the flap, remained alive, and the surface of the wound was granulating. The incisions on the face and cheek had healed. The general health of the child had much improved. I therefore determined to check the disposition to ectropium by paring the edges of the upper and lower lids and uniting them by sutures. This was readily done under ether, and the middle portions of the lids were secured to each other.

On the 19th of April, just fifty days from the beginning of the treatment, the patient was discharged. A sufficient covering was formed for the lid. The eye was normal.

At the present time, September, 1876, the upper lid is perfectly in position; there is a fistulous opening through its middle leading to the superior fornix conjunctivæ. The new tissue forming the upper lid has acquired a dark-brown color, which makes it somewhat conspicuous. There is some fullness of the skin at the inner angle of the orbit where the pedicle was twisted. There is entire comfort in the use of

the eye, and it is free from irritation. The scar which marks the place in the naso-buccal furrow from which the flap was taken can be traced as low down as almost to the lower jaw. It descends below the mouth, because the incision was lengthened in order to bring the cheek up to the side of the nose.

I have a photograph of his present condition, and the boy himself is presented for inspection.

The obstacles to success in the second case were certainly as great as could be encountered. It may be thought that the success obtained was not to be attributed to the use of the flap, but rather to the formation of a cicatrix after the eyelids had been attached to each other. This proceeding is recommended by some ophthalmic surgeons as sufficient. (See Bader on the Eye, p. 55.) But while it may serve for some cases, it cannot be adequate for those in which the entire forehead has been burned and the skin replaced by a cicatrix. To form an eyelid by procuring the growth of a cicatrix is to establish a condition in which, by the slow contraction which continues at least a year, the eyelid will either be again everted, or so much shortened as to be of little use. It is against this tendency to contraction that it is needful to guard by introducing a flap. For the little boy, what was preserved of the flap served a useful purpose by the amount which it actually contributed to the lid, and also by aiding, as it evidently did, in the production of new tissue in the process of granulation.

The operation described is one adapted to exceptional cases, and such were the instances which I have reported. To show that these cases are capable of relief, is the object of this communication.

The PRESIDENT: The next paper is by Dr. Gowers, of London, and will be presented by Mr. M. M. MacHardy.

NOTE ON CHRONIC OPTIC NEURITIS.

BY W. A. GOWERS, M. D.,

ASSISTANT PHYSICIAN TO UNIVERSITY COLLEGE HOSPITAL, AND TO THE NATIONAL HOSPITAL FOR PARALYSIS AND EPILEPSY, LONDON.

I WISH briefly to call attention to a form of optic neuritis which possesses such definite characters and associations as to

seem worthy of special distinction. Its chief feature is extreme chronicity. The appearance is that of a moderate neuritis, which remains absolutely the same week after week and even month after month. I have watched a case for six months without being able to detect, on comparison with a drawing made at the beginning, any appreciable change. But, on examination two years subsequently, the neuritis was gone.

I have seen three examples of neuritis of such chronicity; in each its characters were the same. The outline of the disk was lost under a swelling of moderate prominence, of rather larger diameter than the disk. The centre was a little depressed, and the central portion presented punctiform redness, while the periphery was a reddish gray, with conspicuous, radiating striation from the nerve-fibres. The contrast between the gray, striated periphery and the red centre was well marked. The vessels were of normal size. The veins lost their reflection on passing down the slope of the swelling, but were not concealed beyond its edge, as in more intense neuritis. Around the artery, at its point of emergence in the centre of the swelling, was a little white tissue (only visible on direct examination), contrasting with the punctiform redness. In no case could any defect of sight be detected.

These characters are, of course, merely those of slight but decided neuritis. Nevertheless, they are so distinctive that, after seeing two cases of this kind, I was able to recognize the third on the first examination. All were met with in purely medical practice, viz., at the Hospital for Paralysis and Epilepsy. Each patient suffered from symptoms of disease of the nervous system, but in no case were the symptoms such as would lead, of themselves, to the suspicion of organic brain disease, such as optic neuritis usually results from. In no case was there any sign or symptom to suggest increase of intracranial pressure. Two were chronic cases of convulsive seizure, in every way resembling cases of simple epilepsy; in the third the chief symptoms were headache and occasional attacks of vomiting, but these symptoms had lasted, without increase, for several years. Each case ran as favorable a course as cases of similar "functional" disorder of the nervous system ever do.

This form of neuritis has thus certainly less grave significance than the more acute varieties, and on this account seems worthy of careful observation and study.

Dr. E. Williams: In connection with this case related by Dr. Gowers, I would say that I have a patient under observation, whom I see perhaps once in three months, with chronic disease of the brain, and all the symptoms of locomotor ataxy, and in whom there is neuritis in both eyes, more marked in one than in the other. The characteristic feature of the neuritis is that it has continued about the same for eighteen months, all the symptoms being well marked, and the vision being very much impaired.

Dr. Mathewson referred to a case of well-marked optic neuritis, of which he subsequently read the account in detail, which had continued apparently unchanged for more than three years. The vision, however, had never sunk below $\frac{20}{XL}$.

COLOBOMA LENTIS.

By ALBERT G. HEYL, M. D., of Philadelphia.

I propose in the following paper to offer some remarks upon the congenital irregularity of structure known as coloboma of the crystalline lens. Cases of the kind are clinical curiosities, and so far as my knowledge goes no extended account of them exists. Independent of their mere variety, however, they bear directly upon the process of development of the lens in the embryo, and, mainly with this idea in view, I have been led to give a description of three cases of the kind recently under my own observation, and at the same time to gather and weave in the meagre details relating to the subject scattered far and wide over the field of ophthalmic literature. The history of Case I. is as follows:

Case I.—Friedrich Hess, aged fifty-one, applied for relief for impaired vision at the Eye and Ear Department of the Philadelphia Dispensary. The sight of the left eye had been lost for some time; that

of the right has been rapidly failing. Before this loss of sight, he had found no difficulty in attending to his occupation, that of a peddler. Examination of each eye gave the following result, the appendages of both eyes being normal:

R. E., V. Sn. $\frac{5}{200}$; with $-11 = \frac{20}{200}$. Iris of medium gray color, pupil of normal appearance, excepting below, where it opens into a large cleft in the iris tissue; this coloboma iridis does not extend quite to the ciliary margin, but is separated from it by a small fragment of iris tissue. This span of tissue divides the coloboma into two portions: a larger communicating directly with the pupil, and a smaller about the size of a pin-head, completely surrounded by iris tissue. No tremulous motion of the iris perceptible. After instillation of atropine a slow and but partial dilatation took place. The upper part of the iris scarcely responded to the atropine, while the effect upon the lower portions was quite noticeable. Examination with the ophthalmoscope now revealed very clearly the peculiar condition of the lens, to which your attention is particularly directed. Directly behind the pupillary space a portion of the edge of the lens was seen, not presenting the well-known rounded contour, being perfectly straight and horizontal; on the nasal side and behind the iris, the edge terminated in a small rounded protuberance, which in turn on its nasal aspect touched the equator. Further examination revealed an enormous coloboma of the choroid, extending beyond the optic nerve; the edge of the disk not discernible; the sclerotic in the position of the coloboma bulged outwardly to a considerable extent. One retinal artery accompanied by two veins seen in the upper part of the fundus, but no retinal vessels could be found below; below the optic disk several vessels pierced the sclerotic, which, judging from their size, must have been the short posterior ciliary arteries; one of the long posterior ciliary arteries was traced far forward, and one of the vortex veins carrying the return-blood was seen piercing the sclerotic at the equator of the ball. Whether a cleft existed in the ciliary body, could not be ascertained; refraction through the lens was myopic to the extent of one-seventh. Hypermetropia of one-eighth existed where the lens was deficient. These measurements are only approximative, owing to the cloudiness of the media and other sufficient reasons.

L. E. Pupil occluded; lens completely opaque, having undergone calcareous degeneration. Coloboma of iris, lens, and choroid existed, but, owing to the occlusion of the pupil, it was impossible to make a further examination.

Case II. may be briefly described as follows: George Dowd, aged

twenty, applied for treatment of a chronic catarrh of the middle ear. A coloboma of the iris was noticed in the left eye, and led to a more careful examination with the hope that possibly a defect might be found in the lens. The result of the examination was as follows: L. E., V. = $\frac{20}{100}$, not improved by glasses. A complete coloboma of the iris, i. e., one extending to the ciliary margin, existed. Corresponding to this, there was a slight deficiency in the periphery of the lens, and presenting, in place of a straight outline, one made up of several sinuosities, taking, on the whole, a horizontal direction; the deficiency was so small that it was with difficulty made out that a large coloboma of choroid existed, not including, however, the optic disk; some opaque nerve-fibres were noted extending downward from the optic disk. The refraction was strongly hypermetropic, no cloudiness of the media existed, no dislocation of the lens. R. E., V. = $\frac{20}{20}$. A slight grade of hypermetropia existed; no abnormal appearances were noted, although no dilatation of the pupil was made, and therefore it is impossible to speak with absolute certainty about the condition of the lens.

Case III.—Mary Adams, aged fifty-two, presented herself at the dispensary for some relief for her eyesight. Her condition was as follows: R. E., no light perception; myopia of one-fifth present. L. E., V. = $\frac{20}{30}$. Emmetropia.

A large coloboma of the iris, of unusual form and position, existed; it was elliptical in shape and situated entirely in the inner half of the iris, the latter being conceived of as divided into two portions by a vertical plane; almost the whole inner half of the iris was absent, a narrow edging of iris tissue skirting the ciliary margin. The whole pupil was involved in the coloboma, and, had it been perfect in shape, would have appeared displaced inward. There was no dislocation of the lens and no evidence of any opacities. By causing the patient to look downward, a small deficiency was discovered at the periphery and extending into the substance of the lens to the extent of perhaps a millimetre; its direction in the main was horizontal; its outline not perfectly straight, but uneven at one or two points, resembling closely the last case. The coloboma was situated in the lower half of the lens; no evidence of coloboma was seen in the interior of the eye. The blindness in this eye was accounted for by the existence of glaucoma absolutum. The L. E. did not present on examination, as far as could be determined, any evidence of coloboma.

In order to gain a clear and comprehensive insight into these cases, I propose to speak a little in detail of the four salient clinical features which they present.

1. *The Outline of the Lens.*—The main peculiarity about this in my first case was the straight horizontal edge already described.

R. Wagner[1] describes a similar case in which the lens appeared as if a segment had been cut off from it, leaving a clearly cut straight edge; the lens outline in my second case was somewhat analogous, in that, although presenting several sinuosities, it took on the whole a horizontal direction. Bowman has reported a similar case.[2] This, however, is not the usual condition; as a rule, the edge of the lens, instead of being straight, is curved, the convexity being upward. Thus, Bowman has reported another case[3] in which "the border approached a triangular outline in a way to give an idea of the trilinear arrangement of the segments." Jaeger's case,[4] the same from which the beautiful plates of coloboma of the choroid were taken, was similar, the lens being indented to the extent of about two millimetres, giving one the idea of the under part of a saddle (sattelförmig eingekerbt). Arlt described a case[5] in which a slight notch was discovered in the edge of the lens opposite a raphe in the corpus ciliare, the latter being due to imperfect development. Another case[6] is reported by the same author, in which the deficiency, while being quite shallow, was more extended than in the last instance, the lens being "flach eingekerbt." Schiess has described a case,[7] almost exactly similar, the only apparent difference being in the amount of deficiency, which was still greater than in the last-mentioned case, involving about one-fourth of the equator of the lens. Bresgen has lately described a case[8] in which coloboma of the lens was found on each eye, and, judging from the report of it, resembling very closely in outline Schiess' case.

2. *The amount of deficiency* next claims our attention;

[1] Ammon's Zeitschrift, Bd. iii., S. 288.
[2] Ophthalmic Hospital Reports, vol. v., I., p. 72.
[3] Ibid., p. 2.
[4] Ophthalmoskopischen Hand-Atlas, S. 147.
[5] Krankheiten des Auges, Bd. ii., S. 128. [6] Ibid., S. 129.
[7] Klinische Monatsblätter, 1871, S. 99.
[8] Knapp's Archiv., Bd. iv., II., S. 227.

this varies from a slight indentation to about one-quarter of the lens substance; in no recorded case has it attained to more than the latter amount. Total absence of the lens has been apparently observed in microphthalmic eyeballs, as in the case described by Seiler and Von Ammon;[1] but cases of this kind belong to a different category from the one under discussion, and it is very probable, also, that careful examination of these cases would have revealed either the lens or its analogue occupying an unusual position. Aphakia congenita, resulting from defective development, has never been observed in eyeballs at all well developed, and probably never will, when the part played by the lens, as Becker[2] has remarked, in the development of the eye, is remembered. Be this as it may, it is remarkable to find that, in cases of coloboma of the lens, already given, the deficiency never involves the centre of the lens, its anterior or posterior pole, nor the lens substance in their immediate vicinity; on the other hand, that always the equator with adjoining lens substance is involved, and further, that the coloboma extends completely through the lens from before backward. It may be remarked, in this connection, that sometimes in these cases not only does the lens appear deficient at a particular point, but also to be imperfectly developed in all its meridians, so that, even when the eyeball is fully formed, the lens itself is small; thus, in Bowman's cases No. I.[3] and No. V.[4] Again let us notice

3. *The position of the deficiency*, viz., in the inferior half of the lens, the latter being conceived of as divided into two portions by a horizontal plane passing through its centre. This was true of all the cases already cited, excepting Schiess',[5] in which a small portion of the defect was in the superior half, by far the greater part, however, below the dividing line. The common direction of the coloboma was downward, the lens being supposed to be in normal position; of course, a luxation of the lens would alter the direction of the coloboma. In

[1] *Vide* Ruete, Augenheilkunde, Braunschweig, 1855, S. 635.

[2] Handbuch der Augenheilkunde, Graefe and Saemisch, Bd. v., I., S. 229.

[3] Ophthalmic Hospital Reports, vol. v., I., p. 72. [4] Ibid., p. 2.

[5] Klinische Monatsblätter, 1871, S. 99.

Schiess' case we must notice again an exception; here, without any evidence of luxation, the defect pointed downward and outward. Once more let us notice

4. *Coloboma* of other structures of the eye is not unfrequently an accompaniment of coloboma of the lens; thus, in Wagner's case,[1] coloboma of the iris, but not of the choroid or retina, existed. In my own cases the choroids, irides, and doubtless the retinæ, were affected.

In Bowman's cases[2, 3] no reference is made to it. Arlt's case No. I.[4] was characterized by coloboma of the iris, choroid, and probably retina; a "raphe" existed likewise in the corpus ciliare. Arlt's second case[4] was accompanied by coloboma of the iris, corpus ciliare, and possibly of the choroid. In Schiess' case[6] no mention is made of this condition; the iris, as is evident from the sketch of the case, was perfect; whether any trace of coloboma was to be found in the fundus does not appear. In Jaeger's case,[6] coloboma of the iris and choroid coexisted. In Bresgen's case,[7] coloboma of the other structures did not exist. The same may be said of a case observed by Becker,[8] and also of one communicated by Hirschberg.[9]

From the preceding, it may then be seen that coloboma of the lens is a condition which presents at the place of defect an edge, not rounded as in the normal condition, but either straight in the horizontal direction, or incurved; that the amount of deficiency varies from a slight indentation to about one-quarter of the lens substance, the centre of the lens, its poles, and the lens substance, in the immediate vicinity, being uninvolved; that the lens sometimes, in addition to the defect, is imperfectly developed in all its meridians; that the deficiency is always in the inferior half, and almost, without ex-

[1] Ammon's Zeitschrift, Bd. iii., S. 288.
[2] Ophthalmic Hospital Reports, vol. v., I., p. 72. [3] Ibid., p. 2.
[4] Krankheiten des Auges, Bd. ii., S. 128.
[5] Klinische Monatsblätter, 1871, S. 99.
[6] Ophthalmoskopischen Hand-Atlas, S. 147.
[7] Knapp's Archiv., Bd. iv., II., S. 227.
[8] Handbuch der Augenheilkunde, Graefe and Saemisch, Bd. v., I., S. 230.
[9] Ibid.

ception, entirely so; and, finally, that coloboma of the other ocular structures frequently coexists, but very frequently no trace of it can be found.

Bearing, then, these clinical features in mind, let us endeavor to trace, as far as possible, the connection between them and some points in the lens development, for, evidently, the coloboma lentis is due to an arrest of this formative process.

It will suffice for my purpose merely to mention some of the stages of this process without entering upon its complicated details; those who may wish to examine the subject more closely are referred to the articles by Manz,[1] and also by Arnold,[2] in the "Handbuch der Augenheilkunde," edited by Graefe and Saemisch, or Arnold's monographs.[3] Notice then:

1. The lens is derived from the external layer of the blastodermic membrane, and at a very early period of development separates from it; it then appears as a rounded body, surrounded by a lighter-colored tissue, which is a portion of the middle layer of the blastodermic membrane. This rounded body presents upon section a central lighter-colored portion, composed of rounded bodies and a darker peripheral portion composed of a granular material.

2. The contents of this body undergo various changes, by virtue of which the peripheral portion is found to be composed of elongated nucleated cells, the long diameter being perpendicular to the external surface of the lens, and the inner extremity pointing toward the centre. It is to these peripheral cells that I call your special attention, because it is from them that the lens structure is mainly formed. They do not, however, all contribute in the same degree to the formation of the lens; the cells anterior to the equator are transformed into the epithelium of the anterior capsule; the cells posterior to the equator become transformed into the lens fibres. This latter transformation does not take place in these cells at the same time; the cells grouped about the posterior pole are the first to show signs of increase in length, while those situated

[1] Handbuch der Augenheilkunde, Graefe and Saemisch, Bd. ii., I.

[2] Ibid., Bd. i., S. 288.

[3] Entwickelungs Geschichte des Auges, Julius Arnold.

more toward the equator seem to remain stationary; so that, if a section be made in the meridian of the lens at this period of development, we shall see a cellular mass projecting from the region of the posterior pole into the central portion of the lens, and causing this hitherto rounded space to assume a meniscoid shape. Afterward, the cells at the side begin to lengthen, and are finally converted into lenticular fibres. It is this latter phase of development which Becker[1] has so well observed.

3. The fœtal blood-supply of the lens needs also a brief notice. The lens during its intra-uterine development is surrounded by a close network of vessels which originate as follows: Those covering the anterior surface are offshoots from the vessels of the so-called "cerebral plates," while those on the posterior surface are derived from the hyaloid artery; this vessel may be seen at an early period near the posterior pole of the lens, and from this point offshoots are developed, which gradually cover the posterior surface. This last observation of Arnold explains sufficiently why the cells grouped about the posterior pole should be the first to elongate, as evidently the first signs of growth will be noticed at the place where the blood-vessels first appear; and, as the latter extend on every side toward the equator of the lens, so may we expect to see the remaining cells undergoing the same process.

These statements being clearly understood, we are now in a position to compare them with the clinical features already given, and ascertain something at least about the abnormal processes of development which give rise to this condition of coloboma of the lens. At the outset it must be evident that we cannot conclude that coloboma of the lens arises from any cause acting during the earliest stage of lens development; the constancy of the position of the defect, the position itself, the symmetry of the existing portions of the lens, forbid this supposition. Nor can we look upon this defect as the result of imperfect closure of tissue in a median line, as in the cases of retinal coloboma; the mode of development already described renders some other explanation necessary. Nor, finally, can we conclude that the trilinear arrangement of segments

[1] Graefe's Archiv für Ophthalmologie, Bd. ix., II., S. 1–42.

has anything to do with the causation of this defect, for the defect is not limited to either of the segments, nor does the mode of development warrant such a supposition.

The second statement, viz., that signs of growth are first noticed in the cells grouped about the posterior pole, and afterward in those nearer the equator, gives us a clew to the solution of the problem. It must be evident that, if the development proceed normally in the first-named position, and cease in the second, we shall have a lens perfect as to its centre, defective as to its peripheral portions. Let me here say that it is not asserted that the development of these two portions is entirely independent, the one of the other; very far from it. While, theoretically, we may have a lens in which only a central portion including the poles exists, we cannot possibly have one in which this is absent and the more peripheral portion present. This finds an explanation in the third statement, viz., regarding the blood-vessel arrangement about the posterior surface of the lens. Should the principal vessel already alluded to fail, there will, of course, be no offshoots, and we shall find only rudimental remains of a lens; should some of its offshoots fail, we shall expect to find a corresponding failure in development of the peripheral portion. The extent of the defect and the character of its outline will naturally vary in different cases.

This solution, then, is based upon the vascular supply about the posterior surface of the lens, and requires that, in cases of simple coloboma—

1. The defect must extend completely through the lens from before backward.

2. The central fibres must be intact.

3. The extent of defect and character of outline must vary.

I need hardly say that the clinical features of coloboma lentis, already given, coincide entirely with these theoretical statements.

Let us now turn our attention to one more point. Theoretically, coloboma of the lens may occur with equal facility at any point of the equator, or even, as already hinted, involve the whole equatorial region; clinically, as may be remem-

bered, the lower half of the lens is always involved, the upper half never, unless in connection with the lower, and then very slightly. We notice at once the frequent presence of colobomata of other ocular structures occupying the same relative position, but, for patent reasons, cannot expect to find any direct causal connection between them; much rather must we suppose that both of these conditions are the effect of one cause. The probability would seem to be, that the delayed closure, or the failure to close on the part of the fœtal cleft, must exercise the leading influence in the production of this condition.

The manner in which this process affects the development of the blood-vessels surrounding the lens is not clear to us, and cannot be made so until exact investigation shall have shed more light upon the whole subject of coloboma oculi. Many suggestions have doubtless occurred to all who have given the subject careful thought; but it has seemed to me that to follow them out would only result in drifting into a vortex of useless hypotheses. In my opinion, then, we must at present be content with seeing how this anomalous condition may be produced, providing its exciting cause come into play, the latter being not definitely known to us.

Before bringing this paper to a close, I desire, briefly, to direct attention to the abnormal conditions associated with coloboma of the lens. As among the most prominent of these, let us notice:

1. *Abnormalities of Refraction.*—As a rule, myopia was present in these cases, and nearly always of a high grade. As it may be of some interest, I append the details of the cases so far as they are recorded. Schiess' case: defect exists only in the R. E. This eye only myopic. L. E. emmetropic. Jaeger's case: defect only noted in the R. E. Strongly myopic. L. E. myopic; but not to such an extent as in R. E. Bresgen's case: defect in each lens, and in each eye myopia $= \frac{1}{6}$. In my own case, No. I., with a large defect in the R. lens, myopia $= \frac{1}{7}$. In case No. III. a defect in R. lens, myopia $= \frac{1}{5}$. Other eye emmetropic, and shows no defect of the lens. More rarely we find hypermetropia present as in Bowman's case, No. V., and my own case, No. II.

2. *The Presence of Cataract.*—In my own cases the condition was as follows: Case No. I., aged fifty, a fully developed, somewhat shriveled cataract of inflammatory origin existed in one eye; commencing opacities in the other. Case No. II., lens clear. Case No. III., lens clear. Bowman's case, No. V., aged eighteen, the lenses were partially cataractous. Case I., aged twenty-two, there were faint marginal opacities. Wagner's case exhibited nuclear cloudiness. Bresgen's and Jaeger's cases, each aged thirteen, lenses clear. Schiess' case, aged twenty, there was only noticed some central capsular deposit. In Arlt's cases no reference is made to this condition. Cataractous change in lenses of this kind is, then, not uncommon, and has probably for its explanation the fact that colobomatous eyes must be looked upon as organs in which the processes of nutrition are imperfectly carried on; in fact, Beer,[1] Von Ammon, and others, have asserted that cataracta congenita is of very common occurrence in colobomatous eyes; but experience does not justify this assertion.

3. *Luxation of the Lens.*—This condition occurs at times in these cases, and varies from a slight malposition to a protrusion into the pupillary space; the latter condition may, of course, be followed by a train of glaucomatous symptoms, as in Bowman's case No. I., requiring the removal of the lens. This condition seems sometimes to be in a measure dependent on the small size of the lens; of course, doubtless, imperfect development or destruction of the zonula comes also into play.

In endeavoring, then, to weld these scattered links of observations into the great chain of ophthalmic science, I have taken the eighteen instances of the defect, all that I could find after careful and extended search, and picked out the salient characteristics. I have then detailed as briefly as possible some points of the lens development, and endeavored to show how an arrest of development at a particular period would cause such a condition of affairs as coincided completely with these salient clinical features. Of course, a paper based upon eighteen cases forms but a contribution to the subject; we need, to complete our knowledge of this defect, a larger num-

[1] Handbuch der Augenheilkunde, Graefe and Saemisch, Bd. ii., I., S. 87.

ber of carefully reported cases, accurate investigation both microscopic and macroscopic, and a more definite knowledge regarding the ultimate causes producing coloboma oculi. A few additional remarks have also been added regarding the associated pathological changes, because they have been brought out in the study of the condition, and may serve as a nucleus for further investigations on these points.

DISCUSSION.

Dr. DYER: The paper read by Dr. Heyl has interested me very much indeed. It may, perhaps, be known to some of the members present that I have a number of times brought before the profession the result of observations upon the eyes of criminals after execution by hanging. I have taken the trouble to make such observations upon eighteen or nineteen criminal cases, and from first to last I have found fracture of the lens; sometimes of the entire capsule alone, and at other times of the substance of the lens, but always horizontally. Generally the fracture occurred with vertical lines running from a central fracture upward or downward. In some cases such an appearance was very well marked. It will probably be remembered that I have reported that the horizontal fracture is absolutely constant. The fact that this coloboma is so universally horizontal has induced me to take the liberty of mentioning those cases, as possibly it might throw some light upon the condition of the lens which I have found after execution by hanging. I have never, as yet, met with an explanation that has been satisfactory.

Dr. KNAPP: I have seen a case of coloboma of the lens, which I described very minutely in 1862.[1] At that time I gave the case a good deal of study. There was a saddle-shaped depression in the upper part of the lens, about $\frac{1}{5}$ of the diameter of the lens. It rendered the eye highly astigmatic, and produced ophthalmoscopic metamorphopsia such as we see it in keratoconus. The case is minutely described in my paper on the asymmetry of the eye, and illustrated by drawings.

[1] Graefe's Arch., viii., II., p. 229, etc.

Dr. Gruening: I once had a case very much like the one Dr. Knapp has mentioned. The coloboma was discovered accidentally in the eye of a woman forty-eight years of age, who consulted me on account of presbyopia. On examining her eyes I found this condition present. The lens was not astigmatic. Her sight was $\frac{2}{2}\frac{0}{0}$ without glasses. It shows, then, that this defect in the lens may not alter the refraction at its marginal parts. There was no thickening of the edges of the lens in the vicinity of the defect. There was also no coloboma of the iris or choroid. In fact, the eye, in other respects than those mentioned, was perfectly healthy.

Dr. E. Williams: I have seen two cases within the past three years of coloboma of the iris, double, with alterations in the lenses with spontaneous luxation in both eyes. In one case, a woman about thirty years of age, the lenses were both luxated downward and inward from the coloboma of the iris. I have watched the case during the last three years, and the lenses have gradually subsided until now cataract glasses enable her to walk, and read, and do her work very well. In her case, although both lenses were luxated, there was no straightening of the upper edge, but they maintained a uniform curve. In another patient, where both lenses were luxated, my recollection is, that the coloboma of the iris was downward and inward, and the luxation of the lens upward and outward. In that case, there was not only partial luxation of each of the lenses, but defect in their edges. The edge was bounded by a perfectly straight line. This appearance was the same in both eyes. The third case occurred in a man twenty or twenty-five years of age, and presented in appearance nothing worthy of special mention.

Dr. Knapp: This form of defect, mentioned by Dr. Williams, namely, the straight line, I have also noticed in some cases.

Dr. E. Williams: Strictly speaking, we may call them coloboma of the iris, with defect in the lens, and a condition of the suspensory ligament that allows of spontaneous luxation.

The President: The next paper is by Dr. Noyes.

ADDITIONAL MEANS FOR RELIEVING PRESSURE OF THE EYELIDS IN DISEASES OF THE CORNEA.

By HENRY D. NOYES, M. D., New York.

The importance, in treating inflammations of the cornea, of getting rid of the evil influence which pressure of the lids exerts, is recognized by ophthalmic surgeons, and seems to be little regarded by others.

How important this indication is considered in the New York Eye and Ear Infirmary will be discerned, by noting that the operation called canthoplasty was performed during the last eight years among 53,697 patients 932 times.

In other institutions the ratio would be found not less. Without dwelling upon this proceeding, which has been fully described and advocated in papers published by Dr. Althof, Dr. Allin, and Dr. Agnew, I beg to call attention to further means of carrying out the same indication.

Before doing this, I would like to offer some criticisms upon nomenclature. The term canthoplasty should mean an operation by which the palpebral angle is either constructed or enlarged. To a certain extent this is the effect of the method employed, the conjunctiva being drawn outward into the skin-wound so as to produce this effect. But this is in reality a minor result of the operation, and one which often disappears. The great efficacy consists in the dissecting up of the commissural bands which attach the extremities of the lids to the orbit, and the conjunctiva to the fascia covering the insertion of the *rectus externus*. This dissection is made permanently effective by drawing out and stitching the conjunctiva to the skin. The utility of the proceeding depends upon the relaxation of the lids which is attained, and, as this is mostly secured by the subconjunctival and subcutaneous dissection, I would suggest for the operation the name *canthol-ysis*, and reserve the name canthoplasty for another proceeding, which I shall describe, in which a flap of skin is transplanted to the angle and permanently increases the extent of the canthus. If this innovation be not accepted, it will only remain to employ the awkward phrases conjunctival-cantho-

plasty and cutaneous-canthoplasty to designate the two proceedings.

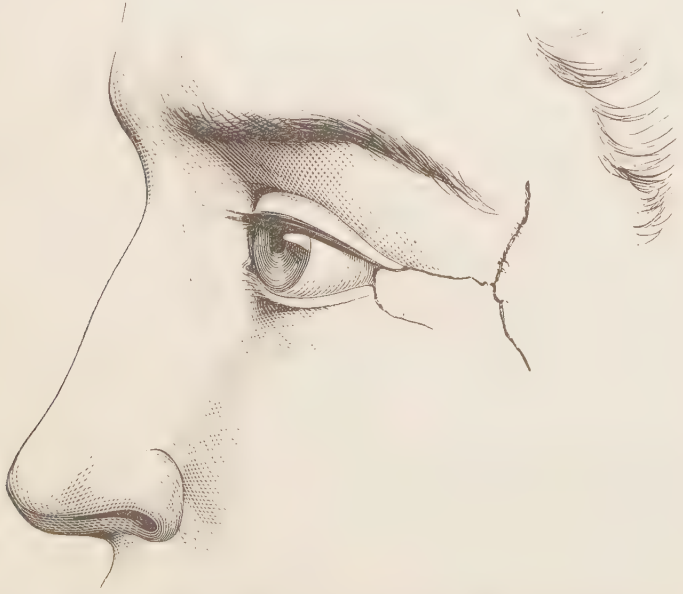
It would still be necessary to use a term to describe the mere division of the angle without dissection or suture. The various operations practised may be styled as follows: 1. Canthotomy, in which nothing but a horizontal incision is made. 2. Cantholysis, in which a lifting of the tissues at the angle from the subjacent parts is performed, and the conjunctiva stitched to the skin. 3. Canthoplasty, as I shall describe, wherein a flap of skin is interposed between the edges of the wound, after having made the same dissections as in the previous operation.

I proceed now to the description of the new method of canthoplasty. It is a proceeding to be adopted in cases of extreme severity. The indications for it are that, while the cornea presents conditions which call for relief by the usual method of cantholysis, the conjunctiva has so far atrophied that none is available in the operation. This condition appears in old cases of trachoma. The palpebral slit is sometimes excessively shortened, the conjunctiva so far shrunken as to almost obliterate the culs-de-sac, and no mucous membrane is to be had for transplantation. The cornea is in a state of opacity or pannus or ulceration. The indications for relief are clear and urgent.

The following method has been successfully employed in all cases:

The patient is etherized, a horizontal incision three lines long is made outward, beginning at the outer angle, the external commissural ligament both of the upper and lower lids is carefully severed until the lids may be easily lifted up from their orbital attachments, the conjunctiva is also loosened; a narrow tongue of skin is then formed, by making incisions upward toward the temple, just beyond the outer end of the eyebrow, constructing a small flap, which has its base below on the level of the commissural incision, and its apex above. This, being loosened, is turned downward and inserted between the edges of the wound. In fitting it to its place, room must be made at the palpebral angle by nicking the margin of the lids above and below. I

avoid, if possible, cutting into the conjunctiva, wishing to spare as much of it as may be secured. In turning the flap down, the incision on its temporal side must be carried lower down than the line of the commissure, to prevent wrinkling. The angle of skin continuous with the upper lid must be dissected up to give room for the flap. In closing the wounds, the first step is to draw together the edges of skin where the flap was removed; i. e., to draw outward the angle of the upper lid and hold it by a very fine pin-suture. The next step is to insert the flap and attach its apex to the conjunctiva. By careful adjustment this may be done without making special deformity—the tendency is to make the flap too large. A good many stitches must be used to fit the parts neatly—not less than ten or twelve—and all the wounds must be closed. The appearance of parts after the operation will vary considerably in different persons, according to the laxity or firmness of the skin, and the accuracy of the operation. Union takes



place promptly, and the irritation of the eye is removed. In some instances a moderate deformity has been produced by the dragging of the upper lid outward. In other cases the

flap has made a somewhat conspicuous fold, which would attract attention. It cannot be pretended that the operation ever beautifies the appearance, but in course of time the changes in the configuration of the region smooth off and scarcely attract notice.

The effect on the condition of the eye has been extremely satisfactory. The relief, which could not be gained by any other proceeding, has been in every instance most grateful. The persons for whom this measure will be required belong mostly to the poorer classes, who, by neglect and inability to care for themselves, have been brought to a deplorable condition. To them considerations of personal appearance have little value compared with the necessity for sight.

The usual indications for this operation are found, as has been said, in the late stages of trachoma; but two other classes of cases have occurred to me for which it has been satisfactory.

The one has been entropium of the *lower* lid consequent upon trachoma. The other is spasm of the orbicularis muscle, as will be related in detail in a case to be reported. The following is the first case:

Mrs. ——, aged thirty-five. The operation consisted in making the usual incision and dissection of the outer canthus by which the lids were perfectly set at liberty. Instead of next removing a narrow strip of skin from the lower lid to secure eversion—and trusting entirely to this—I constructed a small flap from the skin of the lower lid in precisely a similar way as described above; except that, in making it, the incisions, instead of approaching the perpendicular, were made nearly horizontal. The tongue of skin was nearly parallel to the border of the lower lid, and was about three lines wide and three-eighths of an inch long. An additional portion of skin was removed from the lower lid by continuing the incisions toward the nose. The gap thus made served, when closed, to evert the inner portion of the lid, while the tongue inserted at the outer canthus effectively everted the outer portion of the lid, and prevented the possibility of a relapse.

The adjustment of the flap was very correct, and a week after the operation the contour of the lower lid and of the outer angle was very natural. The haziness of the cornea greatly disappeared and the irritability of the eye was removed.

I think this operation fairly deserves a place in the list of methods for the cure of entropium of *the lower lid*, and will be acceptable for those cases which not infrequently occur where mere excision of skin, or Snellen's thread, does not control the deformity. It comes in use for the severe cases in which shrinking of the conjunctiva is the efficient cause of the deformity.

The number of cases for which this operation has been done amounts to eleven. The removal of the irritability of the eye was the object sought, and decided improvement in sight gradually ensued.

A different kind of case and one of a peculiar character deserves report in detail. It illustrates the effect of the combined action of mechanical pressure of the lids and nervous irritability of the orbicularis in causing ulceration of the cornea. It is the case previously alluded to.

It points out how we must sometimes have recourse to means for controlling nervous spasm in addition to the mechanical means of relief.

Henry K., aged forty, farmer, born in New Jersey, was operated on in childhood for cataract in both eyes, and obtained good vision in one eye. In the other there remained some capsule which I removed. In the autumn of 1875 his right eye became affected with keratitis. An ulcer formed at the outer margin of the cornea. It was obstinate in healing, and treatment by atropia, hot fomentations, and finally canthoplasty, did not secure relief for several weeks. When he left the infirmary there was considerable opacity at the outer half of the cornea. The patient is a person of feeble mind, and in body looks prematurely old. He would be taken for sixty years of age; his skin is thin, loose, and dry; he is of small stature, his voice is childlike, and face deeply wrinkled.

In May, 1876, he returned to the infirmary with more severe inflammation of the same cornea. The former ulceration had returned, and the whole tissue was densely white. The eye gave him so much distress that he begged to have it extirpated. Warm fomentations and atropia were again employed, but to little purpose. Then canthoplasty by a flap of skin as above described was performed. The depreciated health of the patient was evidenced in the tardy healing of the wounds. Great swelling occurred, the wounds gaped and suppurated,

and the parts were not properly brought together for two weeks. Meanwhile the inflammation in the cornea continued. During all the time the spasm of the eyelids was excessive. Nothing could check it. The skin was not only very thin, but very mobile, and the facial muscles strong. The lids of the affected eye were habitually squeezed together like the fist. The attempt to examine the eye would bring on an increase of spasm, and no remonstrances could dissuade him from doing it. When the reaction from the operation had subsided, a beneficial effect was obtained upon the eye. The lids could not take so firm a grip on the cornea, and the ulceration began to improve. The progress of improvement was slow, and it became evident that something more must be done to obviate the uncontrollable blepharospasm. I resorted to the fluid extract of conium maculatum (Squibb's), giving 40 drops once daily. The intoxicating effect of the drug was produced, the patient would reel and be dizzy, and the spasm of the lids was less severe. This treatment was maintained for a week with manifest advantage. The effects of the remedy on the general nervous system would pass off in a few hours, but throughout the day the action of the eyelids would be less intense. The complete control of the spasm could not, however, be thus obtained, and I felt the need of some treatment which would permanently stop the morbid action. I determined to try what effect could be gained by division of the fibres of the facial nerve. The trunk of the nerve at the stylo-mastoid foramen is difficult of access, but could be reached, if needful. I have seen a case where it had been severed by a stab behind the angle of the jaw. This entailed paralysis of all the muscles of the face, and I therefore concluded to attempt to divide only those twigs which go to the orbicularis. By means of a knife with short blade and long shank, similar to that I use for dividing lachrymal stricture, I made a subcutaneous incision along the zygoma both upon the bone and against the skin. I entered the knife nearly over the middle of the malar bone, and made the first cut, as stated, along the zygoma, going almost to the ear. I next turned the point of the blade upward to the outer border of the orbit, and again cut both upon the bone and against the skin. Lastly, a similar cutting was made along the lower border of the orbit. All of these incisions were made through a single puncture in the skin. A thrombus of moderate extent was produced.

The use of conium was discontinued. The reaction following the incisions was not severe. On the following day it was evident that the orbicularis had in a marked degree lost its contractility. The

power of shutting the lids was preserved, but the violent action could not be performed.

In a few days the swelling caused by the incisions subsided, and the abatement in the power of the orbicularis was very manifest. The skin could not be wrinkled to any such degree as in the case of the other eye. This condition of the muscle continued until the time of his discharge, which was on the fifteenth day after the neurotomy. The condition of the eye began to improve more rapidly immediately upon the division of the nerve-fibres, and advanced so far that on the fifteenth day succeeding he was enabled to go out and return to his home.

DISCUSSION UPON DR. NOYES'S PAPER.

Mr. Carter: I would ask Dr. Noyes how far the subcutaneous division of nerves was carried; whether it included the branches of the fifth pair or only the branches of the motor nerve of the orbicularis?

Dr. Noyes then described the operation, and pointed out the course of the incision, and stated that he cut every twig of nerves which passed over the zygoma.

Dr. C. R. Agnew: I would ask Dr. Noyes if it be not possible that the beneficial results which occurred in these cases from subcutaneous incision were due rather to myotomy than to neurotomy? It would be expected in cases, such as have been described by Dr. Noyes, where the orbicularis muscle had been long in exercise, that it would be largely developed, and a free incision, so made as to traverse the origin of the muscle, and cut most at right angles to the course of its fibres, would be in fact free subcutaneous tenotomy. If that view obtains, it does not deteriorate from the value of the suggestion, and the operator would feel more certain that he divided muscular tissue than nerves. Is it not possible that the salutary effect is produced by myotomy and not by neurotomy? I think the general experience has been that division of nerves has failed to permanently relieve the condition for which they have been divided. So, from this fact, which I think is historical, and from the description which Dr. Noyes gives, I should be disposed to attribute the value of the treatment to a free form of

tenotomy rather than to neurotomy. At all events, the suggestion is valuable, and in some cases it may not be necessary to resort to the canthoplastic procedure.

Dr. Noyes: In reply to the inquiry whether the good results were brought about by myotomy or neurotomy, this may be said: Before this subcutaneous division was employed, the outer canthus had been thoroughly divided twice, first, in the customary manner, and second, in a peculiar manner, so as to thoroughly sever the circular muscular fibres. This not accomplishing the object, another method was used in which the knife not only cut to the bony structure, but the edge was turned outward and cut toward the cutaneous surface as thoroughly as possible without going through. I was fully persuaded that the result was dependent upon severance of the fibres of the nerve. The point of entrance was at the junction of the zygoma with the malar bone, and the cuts were made toward the ear along the zygoma, and upward parallel to the edge of the orbit, and obliquely downward and inward, but not reaching the canine fossa. In this way, the edge of the orbicularis was cut, but all its belly was not incised.

Dr. E. Williams remarked that, in the celebrated case of blepharospasm of Von Graefe, neurotomy was the operation that brought about relief.

The President announced a communication from Dr. E. Seguin in regard to the adoption of a uniform system of examining and recording cases, which, by motion, was referred to a committee consisting of Drs. Roosa and Loring.

The Congress then adjourned till the following day.

Wednesday, September 13, *Morning Session.*

The Congress met at 10.30 A. M., pursuant to adjournment.

The minutes of the last session were read and adopted.

Dr. H. W. Williams presented a communication from Prof. Donders, of Utrecht.

On motion of Dr. Knapp, Dr. Williams was requested to acknowledge by letter the communication received from Prof. Donders, and to convey to him the thanks of the Society for his kind message.

The President then announced the regular order of business, and called on Dr. Alt.

ON SYMPATHETIC NEURO-RETINITIS.

By ADOLF ALT, M. D., New York,

RESIDENT ASSISTANT SURGEON TO THE NEW YORK OPHTHALMIC AND AURAL INSTITUTE.

While engaged in studies on the nature and anatomical causes of sympathetic ophthalmia, the results of which will be published in the next number of the *Archives of Ophthalmology and Otology*, I found that there are mentioned in the literature the following six kinds of sympathetic affection: irritation, iritis, irido-cyclitis, irido-choroiditis, neuro-retinitis, and corneal affections (the latter only in four doubtful cases).

Among these the cases of sympathetic irido-cyclitis are very small in number. This is readily understood, since very frequently it may be impossible to state that an inflammation of the uveal tract involves only its anterior portions. No doubt, cases of real irido-cyclitis have been reported as sympathetic irido-choroiditis.

Another striking fact was, that cases of sympathetic neuro-retinitis are mentioned but very seldom; for this I can account only by the supposition that, in many cases, the symptoms of neuro-retinitis were hidden by the products of irido-choroiditis and hyalitis. In the literature which I had at my disposal, I could find only four cases of sympathetic neuro-retinitis. This fact, and the kindness of Drs. H. Knapp and E. Gruening of this city enabling me to add to these cases three new ones, made me think it appropriate to call the attention of this society to this subject.

The first two cases of sympathetic neuro-retinitis have been described by the late Prof. von Graefe, in the twelfth volume of his "Archives," and are the following:

Case I.—A patient, thirty-five years of age, had been blind in the left eye from his childhood. A short time before he came under Von Graefe's care, he had noticed a change in the appearance of his blind eye, and the eye had become painful. When he was first seen by Von Graefe, he had no perception of light in his left eye. The globe was slightly atrophic, there was circumcorneal injection, and a chalky lens lay in the anterior chamber. Von Graefe extracted this lens the same day. The operation was followed by redness of the globe, great tenderness, etc., a few days afterward by hæmorrhages into the anterior chamber, hyperæmia of the iris, and ciliary neurosis. These conditions were soon aggravated to such a degree that Von Graefe made the diagnosis of plastic cyclitis, respectively choroiditis. During the following weeks, however, these serious symptoms gradually subsided. There was but very little tenderness on pressure left in this eye, when suddenly, six weeks after the operation, the sight of the other, the right eye, began to fail. Its vision was diminished to $\frac{4}{200}$. There was torpor retinæ, and the excentric vision on the whole temporal side of the visual field was so indistinct that, even with good illumination, the patient was not able to count fingers on that side. The retinal veins were tortuous and dilated, though more on the inner half. The retina itself showed a diffuse dimness, so that the choroidal contour of the disk was veiled, and several parts of the retina near the vessels were grayish. After a few days these conditions were followed by serous iritis, and almost entire paralysis of accommodation. Vision reduced to $\frac{2}{200}$ to $\frac{3}{200}$. Here the inflammation seemed to have reached its height, and, under the application of leeches and internal treatment, consisting of sublimate and iodide of potassium, the

patient recovered so far that his vision finally was $\frac{16}{200}$. The paralysis of accommodation and the neuro-retinitis disappeared, and only some atrophic changes in the choroid remained after such a severe inflammation. Von Graefe, it is strange to say, attributes the occurrence of sympathetic affection in this case to the extraction of the chalky cataract.

Case II.—The patient, twenty years of age, also had been blind in the left eye from his childhood. A few months before coming under Von Graefe's care, he had noticed that his blind (left) eye grew painful, and at the same time that the visual power of his right eye was failing. On examination, the left eye showed total detachment of the retina, and whitish-yellow masses, shining through the retina, produced the suspicion of an intraocular tumor. The diminished tension of the globe, however, and the form of these masses, caused Von Graefe to explain them as either thickened or chalky products of a chronic inflammation of the choroid. The ball was but little tender to the touch.

The degree of the diminution of sight in the right eye is not mentioned, but stated as being slight. The peripheric vision, however, was very indistinct, and there was torpor retinæ. The retinal veins were tortuous, the retina itself was diffusely infiltrated, though less than in the case previously related. There were also circumscribed opacities in the vitreous, and a few atrophic changes in the equatorial part of the choroid. After the enucleation of the left eye, the right gradually improved.

The enucleated eyeball showed funnel-shaped detachment of retina and considerable chalky masses on the inner surface of the choroid.

The next two cases have been reported by Dr. T. R. Pooley, of this city, in the second volume of the "Archives of Ophthalmology and Otology."

Case III.—A boy, nine years of age, was struck upon his left eye by a clam-shell. When examined by Dr. Pooley, there was a wound at the lower and inner corneo-scleral margin, in which the iris was engaged and covered by adventitious tissue. The anterior chamber was filled with blood. Four weeks after the injury had occured, symptoms of sympathetic irritation made their first appearance in the right eye. Four days after this, he was seen by the doctor, who found the injured eye hyperæmic, painful on pressure, and a whitish exudation in the vitreous behind the lens. The right eye was injected, the pupil sluggish, and there was a posterior synechia toward the nasal side. The fol-

lowing day Dr. Pooley enucleated the left eye. This operation caused a temporary amelioration of the eye sympathetically affected, but soon the disease of this eye turned into irido-choroiditis. Two months and a half after the injury, Dr. Pooley observed the conditions mentioned hereafter: retinal vessels full and tortuous; the optic disk covered by exudation, so as to obscure its borders and vessels.

The course of this neuro-retinitis could not be followed by observation on account of the obscuration of the vitreous. The vision finally remained $\frac{5}{200}$.

The conditions of the enucleated eyeball were the following: A perforating wound at the corneo-scleral junction in which iris and ciliary body were embedded. Chronic irido-choroiditis of partly plastic, partly purulent character. The ciliary nerves were normal.

Case IV.—The patient, fifty-nine years of age, had received an injury to his left eye forty years ago. The injury had been followed by a severe inflammation, and, after this had subsided, he suffered from time to time from new attacks, the result of which was staphylomatous degeneration of the eye. About four months before the patient entered the New York Ophthalmic and Aural Institute, he injured the left (staphylomatous) eye, and caused by that means a new inflammatory attack which led to perforation and atrophy of the globe. Three weeks before his admission to the hospital, the sight of his right eye began to diminish. When he entered the hospital, the left eyeball was shrunken, very hard, and tender to the touch. The right eye counted fingers at 5′ only. There was a shallow anterior chamber, dull pupil, discolored iris, numerous synechiæ, some of which were torn by the use of atropine; vitreous cloudy; retina seen as if through a veil, but sufficiently well to distinguish a high degree of hyperæmia of the disk and its vicinity; uniform semitransparent exudation on and around the disk, the borders of which were completely concealed. The injured (left) eye was then enucleated, and the patient gradually recovered. The final condition of the right eye was: Vision $\frac{20}{30}$; a low degree of hyperæmia of the disk and surrounding retina, which has not disappeared as long as the patient has been under observation.

In the enucleated eyeball, iris and ciliary body could only be traced by their pigment. Partially atrophic, partially purulent choroiditis was present; furthermore, a cyclitic membrane, detachment of the retina, and degeneration of this membrane into connective tissue.

To these reported cases I beg leave to add the following

three cases of sympathetic neuro-retinitis, recently observed in the New York Ophthalmic and Aural Institute, one of which you see before you:

Case V.—The patient, T. D., thirty-five years of age, came into the hospital under the care of Dr. E. Gruening. His left eye had been lost fourteen years previously by a suppurative disease of the cornea followed by anterior phthisis. He had worn an artificial eye without any annoyance for many years. Feeling, however, that the sight in his right eye failed rapidly, he presented himself for examination, of which the results were the following: The fundus in the vicinity of the disk and macula lutea exhibits the changes peculiar to Bright's neuro-retinitis. There is complete absence of the inner half of the visual field. In the outer half, the patient sees movements of the hand and counts fingers with difficulty. The suspicion that it might be a sympathetic affection induced Dr. Gruening to advise the patient to have his left atrophic eye enucleated. The patient, however, did not consent until three weeks after, when decided irido-choroiditis had supervened. The following was the condition of the right eye just before the enucleation of the left: Marked circumcorneal injection; iris swollen and hyperæmic; some pupillary synechiæ, a part of which are torn by instillation of atropine; aqueous humor turbid; floating opacities in the vitreous, so that, although a red reflex could be obtained, no details of the fundus could be observed. Intraocular pressure + T1. No perception of light.

As, in spite of the enucleation, the right eye did not improve, and its intraocular tension was increased to + T2, Dr. Gruening performed an upward iridectomy four days after the removal of the left eye. The following day there was chemosis and considerable swelling of the lids, some infiltration of the wound, and a spongy exudation in the anterior chamber,—T1. The patient was put under the influence of mercury and leeched several times, under which treatment the inflammatory symptoms subsided. When he was discharged from the hospital, there was still some circumcorneal injection, faint perception of light,—T1. I made the examination of the enucleated eyeball, and found that the cornea was transformed into connective tissue, to the inner surface of which the atrophic iris was totally adherent. There was also atrophy of the ciliary body after plastic cyclitis; choroiditis with colloid excrescences of the lamina vitrea; inflammation with pigmentation of the detached retina; atrophy of the optic nerve.

Case VI.—The patient, T. L., eleven years of age, was first examined by Dr. Knapp some days before he entered the hospital. The history and condition of the eye at that time were the following: Six weeks since, a gun-cap was shot into the boy's right eye, and removed by Dr. C. S. Bull, of this city, two days afterward. Since that time, the eye continued inflamed. About a week before, the left eye had begun to be red and weak. There was in the right (injured) eye an elevated scar at the outer, lower, corneo-scleral margin, in which the iris was embedded. Iris greenish, swollen, and pervaded with many dilated blood-vessels. In the left eye the surface of the iris was irregular, and there were small, posterior synechiæ all around the pupil. While, in the right (injured) eye, the dimness of the media made it impossible to discern any details of the fundus, pronounced venous hyperæmia of the papilla and retina was seen in the left. The disk and its surroundings show a grayish infiltration. Vision in the left eye is $\frac{4}{200}$, in the right (injured) eye $\frac{2}{200}$. Tn, and visual field complete in both eyes.

A few days after this first examination, when the patient entered the institute, the condition of both eyes was but very little altered. Vision was diminished in the right eye to $\frac{1}{200}$, while in the left it still was $\frac{4}{200}$. On the same day Dr. Knapp made the abscision of the incarcerated iris, which had the effect that, in the next few days, the vision was increased to $\frac{2}{200}$ in the right and to $\frac{5}{00}$ in the left eye. Very soon, however, the vitreous of the left eye became cloudy, so that the conditions of the fundus were unrecognizable, and sight diminished to mere perception of light in both eyes. At the same time, the old scar in the right eye protruded more and more, and in the left eye a total circular synechia was formed. These changes developed in spite of a strong mercurialization. In this condition, the eyes remained for a short time unchanged. Then the periphery of the left iris began to bulge, and during the night the patient suddenly felt intense pain in the left eye. On examination, I found the intraocular pressure increased to +T3. Leeches and several doses of morphine had to be employed to relieve the pain. From the day of this acute attack of consecutive glaucoma, the left eye began to grow staphylomatous. During the next few days, the inflammation increased rapidly. The sclerotic and cornea were invaded by innumerable blood-vessels, and the lids could not any longer be closed over the eyeball. A few days later, the eye was perforated in its most distended part, that is, at the upper ciliary region, and a great quantity of yellow pus was discharged.

During all this time the protruding scar of the right eye had grown to the size of a pea. The hope, that a black body, showing itself near the staphyloma at the insertion of the iris, would prove a foreign body, and come out, failed. The staphyloma increasing more and more, Dr. Knapp decided upon cutting it off. This operation was performed five weeks after the patient had entered the hospital. A large quantity of coffee-colored fluid (the degenerated vitreous) escaped through the wound, but no foreign body was detected. On microscopical examination, I found that the protrusion, which had the appearance of a staphyloma, was merely a granuloma of the iris.

When the patient was discharged, I made the following notes: No perception of light in either eye. The right is smaller, intraocular pressure —T1. The region of the injury again protruding. The left eye in the same staphylomatous condition as before. Some yellow pus oozing through the rupture in the upper ciliary portion of the sclerotic. The eyeball, however, is tolerably hard. This hardness, from what I have seen in pathological specimens, I think, is the result of a considerable new formation of tissue in the interior of the globe.

When I saw the patient two weeks ago, in order to persuade his parents to bring him before this society, atrophy of both eyes was manifest.

I should still mention that this case was complicated with trachoma, which may, perhaps, have added to the irritation, and so partially caused the disease to take such a disastrous course.

Case VII.—The patient, W. H., thirty-eight years of age, a colored man, whom you see before you, came first to the dispensary of the New York Ophthalmological and Aural Institute on the 21st of August, with the following history: About twelve years before, he suddenly almost entirely lost the sight in both eyes. There were great pain and redness. This condition continued to grow worse in the right eye, while the left recovered good vision. Since that time, the patient had frequent attacks of great pain in his right eye, which caused its protrusion and complete blindness. He had been advised by several physicians to have this eye removed, lest it might one day injure his healthy eye, but he did not consent. For six days a rapidly increasing failure of sight had taken place in the left eye. On his admission to the hospital, the following condition was found: Total staphyloma and blindness of the right eye. The left eye shows no external changes. He sees only movements of the hand. The ophthalmoscope reveals diffuse neuro-retinitis, the infiltration reaching nearly over the whole area of the retina. The disk can be recognized only

by the concentric course of the broad, tortuous veins, which were, however, also partially veiled by the infiltration. There were some few striped hæmorrhages near the vessels. The media were entirely clear, so that the fundus could be easily seen.

Though no complications, such as pain, lachrymation, photophobia, etc., were present, it was decided to take the right staphylomatous eye away, since on the one hand it was entirely useless, and on the other could, by sympathy, perhaps, be the first cause of the inflammation in the left. He entered the hospital on the 23d of the same month, and I performed the enucleation. Operation and course of healing presented no unusual features.

The treatment under which the patient was kept since that time consisted merely in a dark room, and three-tenths of a grain of sublimate daily. Three days after the operation, a large hæmorrhage in the region of the yellow spot was seen. It was semilunar in shape, and had sharp-defined margins. A smaller one, of a more striped character, was on the nasal side. The picture resembling that of Bright's neuro-retinitis, I made an examination of the patient's urine, but detected no trace of albumen. From the time when the enucleation of the right eye was performed, we witnessed a gradual and rather rapid and surprising improvement in the left. The pronounced milky opacity of the retina cleared up, so that, about a week after the operation, the temporal border of the optic disk was visible. Though the large hæmorrhage below the macula lutea has not yet disappeared, the patient's excentric vision is now $\frac{20}{30}$.

I think, if ever we have a right to make the diagnosis *ex juvantibus*, we certainly are justified in doing so in this case; and I therefore unhesitatingly pronounce it an instance of sympathetic neuroretinitis.

The enucleated eyeball exhibited so many and interesting changes, which would be worthy of a detailed description, that I dare not, therefore, occupy the precious time of the International Congress. Briefly enumerated, they were the following: total scleral and corneo-scleral staphyloma; central and disseminate atrophic chorio-retinitis; exceedingly deep, glaucomatous excavation; detachment of the vitreous body, and atrophy of the optic nerve.

The number of reported cases of sympathetic neuro-retinitis is too small for statistical conclusions. The following remarks, however, may be of interest:

In six of the seven cases, sympathetic neuro-retinitis was combined with irido-choroiditis. In one only it ran its course without any complication.

In five of the seven cases, the patients entirely recovered, with the exception of one, whose final vision was only $\frac{5}{200}$. In four of these cases, the enucleation of the eye first affected had been performed.

Only two cases led to complete destruction of the eyeball; both showed a state of increase of intraocular pressure.

The time between the affection of the eye first diseased and the appearance of sympathetic neuro-retinitis was, severally, forty years, thirty-five years, twenty years, fourteen years, and twelve years, two months and a half, and five weeks.

From the foregoing report, it results that, of these seven eyes, which were described as having produced sympathetic neuro-retinitis, four were lost by a disease without an injury, whereas, in the remaining three, an injury was the first cause of the affection.

This statement, that sympathetic neuro-retinitis was more frequently induced by a non-traumatic affection of the eye first attacked, is very remarkable, since, among one hundred cases of the other forms of sympathetic ophthalmia, according to statistics I recently made, eighty resulted from an injury to the eye first diseased.

The President: These things are of such rare occurrence, and so important in the chain of morbid phenomena resulting from supposed sympathetic disease, that I should be very glad to hear something further on the subject, so far as I am individually concerned. I will here state the results of the examination of two eyes, which I have made within the last two months. In one, a foreign body had entered through the cornea and iris to the margin of the lens, and lodged in the ciliary region, and was followed by severe inflammation and extreme pain for some two weeks, attended with risk to the other eye. I made the enucleation, and proceeded at once to the examination of the eye. This revealed an abscess around the foreign body, just at the back part of the ciliary region, in the direction in which the body entered.

The vitreous around the abscess was somewhat hazy, but there was no general suppuration, the rest of the vitreous being perfectly clear and natural, at least appearing so in a hurried examination; but there was the most marked neuro-retinitis that I have ever seen in a section of the eye. The disk was very greatly swollen, infiltrated, and hazy; the vessels could not be traced over the disk, in consequence of the exudation; the veins were enlarged, and, in fact, there were all the symptoms of neuro-retinitis, though mostly confined to the optic nerve. A few days afterward, another case occurred in a man who was injured by a shot. The shot was discharged at a bird on the ground, at an angle from the person injured of perhaps forty-five degrees, and the parties all stated that the wagon in which the man was sitting, looking backward, was at least a hundred yards from the man who discharged the load, which was bird-shot. The man felt a stinging pain in his eye, and, when he came to me, was suffering considerably. I enucleated the eye, after making the diagnosis of the entrance of a foreign body, and I found a flattened shot in the eye, which had passed backward, and had struck the sclerotic on one side, and then rebounded through the centre of the vitreous, and lodged against the sclerotic on the opposite side, making an extensive plowing destruction of the vitreous. I judged of its course by the mark, and by the extensive inflammation and suppuration of the vitreous in the parts through which it had traversed. In this case, also, in addition to these changes, I found a very intense neuro-retinitis, but more marked, of course, in the disk than it was in the surrounding retina. In both of these cases, of course, it was not possible, previous to enucleation, to diagnose its condition, but I am led to believe that, in most cases, or, at least, in many cases, of penetration of a foreign body into the eye, with severe resulting inflammation, and subsequent danger to the other eye, there is an early neuro-retinitis. Whether that disappears and leaves the sight good, in case the foreign body does not destroy the eye, or whether it results in atrophy, or whether it continues in the same condition, of course, are questions to be settled by sections of enucleated eyes hereafter.

Dr. Noyes, of New York: I would like to ask Dr. Alt

how intimate was the connection between the injury of the eye first lost and the sympathetic trouble of the remaining eye. I quite comprehend that, in some cases, the period of time intervening between the occurrence, in the two eyes respectively, was so brief as to fully authorize the inference that the neuro-retinitis was consecutive, and to be regarded as a sympathetic affection, but I did not understand that that could be so distinctly asserted in all the cases he stated. I wish to ascertain how long an interval of time elapsed, and what was the condition of the eye which was supposed to be the cause of the second trouble. I think that the irritation of the optic nerve, *per se*, is, in a very large number of cases, one of the primary causes of the difficulty in the second eye, and I have been accustomed with some patients, in whom the sympathetic difficulty was apprehended, because of an injury, to lay great stress upon the peculiar delicate infiltration and haziness of the optic nerve of the eye, the integrity and safety of which are then under discussion, and when the true amount of this inflammatory condition has been clearly made out. Of course, I exclude errors of refraction in the remaining eye, and they must be very carefully excluded, for I have known practitioners to make very grave mistakes in that way, confounding an eye which was the seat of a refractive error with the condition due to sympathetic trouble. But, where these errors can be by careful examination excluded, and these signs of minute changes in the tissues of the optic nerve are clearly made out, I have been accustomed to regard that as one of the initiatory stages of the sympathetic affections which calls for the extirpation of the damaged eye; and the other lesions which Dr. Alt has referred to are, I imagine, much more rare.

Dr. Derby, of New York: I should like to repeat from memory the notes of a case that seems to me to bear on this subject, although the case itself presents some points that, I think, render it a weak one. I was called to see a person three or four months since, in order to give evidence as an expert. It was a young man of twenty, who, six months before, had been injured about the left eye. The injury was by a piece of iron impinging on the edge of the orbit, leaving him, when I saw him, in this condition. Just beyond the

juncture of the middle and inner third of the superior orbital margin was a deep notch, showing a considerable loss of bony substance. The eye itself presented no signs of injury externally. Upon pressure in the region of the superior rectus, and still not upon the eyeball, there was pain. This is a very marked point in the case. The examination by the ophthalmoscope revealed a rupture of the choroid, extending around the papilla, and atrophy of the optic disk and retinal vessels. In the other eye, there were signs of beginning retinitis. The outline of the disk was not distinct; the veins of the retina were tortuous. The vision of this second eye was somewhat reduced; accommodation painful; the man read with difficulty. There was no doubt in my mind of the beginning of trouble in this eye, which I connected with the injury in the other. There was no evidence of trouble in the ciliary region. The only evidence of lesion in the eye was the rupture of the choroid.

Dr. Knapp: The case related by Dr. Derby was certainly an unusual one, and I should rather hesitate to accept his statement that sympathetic trouble may be produced by injury to the surroundings of the eye. I think there must have been injury to the globe itself, for some of the symptoms could be attributed to such an injury. If the eyeball had shown no changes, Dr. Derby's conclusion would be more convincing.

Dr. Risley, of Philadelphia: The interesting paper to which we have listened, and the subsequent discussion, have awakened a recollection of two cases, about which I was unable to satisfy my mind at the time of their occurrence. The first, which occurred about four years ago, was a man who had been thrown from his wagon, striking on the left supra-orbital ridge against the curb-stone, producing considerable injury. That eye was apparently lost by the injury, and six years later the right eye began to fail. He came to see me between seven and eight years after the accident, almost blind in both eyes; entirely so in the left, and he could only count fingers with the right. Media in both eyes were clear. I found atrophy of the optic nerve in both eyes, and he himself

ascribed the cause of the loss of the right eye to the injury to the left, although it had occurred some five or six years after the injury to the first eye. But, on being closely questioned, he stated that his right eye had been failing some time before he had sought advice. I was a little at a loss to account for it, but, since hearing this paper, I am convinced that it was possibly sympathetic trouble, and, up to the time of the failure of the right eye, he had, from time to time, perhaps, trouble with his left. The other was a case which occurred three or four months ago, in which a gentleman received a foreign body in his right eye about a month before I saw him. He suffered a great deal of pain in the eye, and for a week past the tension had been diminished. I found an evident commencing neuro-retinitis in the uninjured eye, with all the ordinary symptoms. I enucleated the injured eye, and after two or three weeks the symptoms in the other eye subsided, but I think they were more resisting than has ususually been the case in my experience, when there were not more obvious reasons for them.

Dr. Harlan, of Philadelphia: I am reminded of a case which came under my observation some years ago, where one of the eyes had been completely destroyed, and the other had very soon afterward commenced to fail. At the time I saw the party, he was completely blind. The ophthalmoscopic examination revealed absolutely no other indication of disease than a very well-marked instance of atrophy of the optic nerve. The appearance of the eye was, in all other respects, quite normal.

Dr. Alt: Four of these enucleated eyes have been examined, and in all the four there was a disease of the optic nerve of the eye first injured or first diseased, and according to the examination of thirty-two eyes, which have been enucleated for sympathetic trouble which had already occurred in the other eye, and according to the statistics in one hundred and ten cases compiled from literature, I found, I think, that in at least eighty per cent. of the cases where sympathetic ophthalmia had occurred the optic nerve and retina were found diseased in the eye which had been enucleated. Hence I came to the conclusion that we have no right to say that the

ciliary nerves are the sole cause of sympathetic trouble, that they *only* produce the sympathetic ophthalmia in the other eye; but that the optic nerve is in many instances also diseased, and by this disease, mechanically, sympathetic ophthalmia is produced in the other eye; and I think, therefore, since in four of these eyes I found the disease in the eye first injured or diseased, that we can also draw the conclusion that the disease of the optic nerve in that eye was really the cause of the sympathetic ophthalmia of the optic nerve and retina in the eye sympathetically affected.

Dr. KNAPP: One of the cases referred to by Dr. Alt was seen by several oculists in New York. The patient came to me five or six weeks after an injury of his right eye. He had pronounced sympathetic neuro-retinitis in the other eye, and neuro-retinitis in the injured eye, so that retinitis was only one of the symptoms of sympathetic trouble; but, in the case of the colored man, a connection between the primary affection and the neuro-retinitis was not so plain as the doctor stated, his right eye being degenerated for a number of years; but the left eye had a pure and well-marked neuro-retinitis. The failure of sight in this left eye was quite rapid during six days. We could detect no cause for the neuro-retinitis, and we thought, as the other eye was useless anyhow, that possibly this neuro-retinitis might be sympathetic. As soon as the degenerated eye was enucleated the recovery of the other was quite surprising.

Dr. NOYES, of New York: I would merely like to state as clearly as I can how the matter strikes me. We have two classes of sympathetic trouble, the one arising after recent injury, and the other of degenerated eyes, and from both these causes we are well aware that sympathetic trouble takes its origin. Now, sympathetic trouble can only be proved, to the satisfaction of the surgeon, by what follows on the enucleation of the bad eye, and this man's case is a satisfactory one. Then, furthermore, the lesions which belong to sympathetic trouble of the sound eye are commonly those of the ciliary nerves. Dr. Alt has the merit of showing us that they also may primarily occur in the nerve track. One other point, which Dr. Alt has only hinted at, is, that he believes that

sympathetic trouble can travel around the optic nerves, *per se*, and is not necessarily confined to the communication through the ciliary nerves. Now, that is, as yet, beyond our standpoint in pathological anatomy. It is an interesting question to be worked up, and we should be very glad of any contributions on that point, but it would require rigorous demonstration to make us as confident of that chain as we are now confident that the chain follows along the track of the ciliary nerves.

ON ORBITAL TUMORS.

By H. KNAPP, New York.

I PURPOSE to make some remarks on some of the *more important types of orbital tumors*, illustrating the subject by cases, of which I can show either the patient or the specimen. I shall abstain from a detailed description of these affections, since that, belonging to the sphere of special literature, would here be out of place.

1. *Orbital Exostosis.*—Only four times in my own practice, which at present amounts to about forty-seven thousand eye cases, have I come across orbital exostosis. Never, during my studies, nor in visiting ophthalmic institutions, had I the chance of seeing one example of it. I mention this to give an idea of the rarity of the affection, as far as my personal observation entitles me to guide my judgment.

The *first case* that came under my care was an ivory exostosis, which extended from the roof of the orbit toward both the orbital and the cranial cavity. It had steadily and perceptibly grown for two years, producing exophthalmus, and, ultimately, repeated attacks of an irritative cerebral affection (meningitis), which lasted about six weeks, and resembled typhoid fever. By a very protracted operation, I succeeded in removing, with Heine's bone-saw, only a part of the orbital portion of the tumor. The patient died eleven days after the operation, from another attack of meningitis. The case is minutely described in "Graefe's Archives," vol. viii., No. 1, 1861, pp.

239–258. The specimen, obtained partially by the operation, partially by the autopsy, formed a roundish tumor of about two inches in diameter. Its texture was that of homogeneous, compact bone-substance, a type of ivory exostosis.

The *second case* was that of a lad who, in 1865, presented himself to me with a slow-growing tumor about the size of a walnut, of bony hardness, situated at the inner, upper margin of the orbit. I removed it with chisel and mallet. The wound healed *per primam*, and there has been no relapse.

The *third case* is that of the man before you. He is thirty-six years of age. Nineteen years since, he first noticed a hard swelling at the root of his nose, which very slowly but steadily increased, so that, three months ago, it had attained the size of a small apple, situate on the root of the nose, and sending a prolongation, the size of a walnut, into the inner part of each orbit, crowding the eyes toward the outer walls of their sockets. There had never been pain, disturbance of sight, nor other inconvenience connected with the tumor. He was sent to me by his employer, on account of the disfigurement and the intrusion of the growth into the orbits. The tumor was somewhat nodular, immovable, of bony hardness, except in one small space, where it felt soft and fleshy. I advised removal of the growth, and performed the operation on the 2d of June, 1876, in the following manner:

A vertical incision was made from the glabella straight downward over the whole extent of the tumor, about two inches in length; then another, at right angles to the former, from one orbit to the other, crossing the tumor horizontally. Both incisions were made with a strong knife, and went through the skin and the periosteum down to the bony substance of the tumor. The four triangular flaps were now cleanly dissected off. The soft part above mentioned proved to be a cyst in the connective-tissue cover of the tumor. Seeing that I had to deal with the ivory variety of the osteoma, I proceeded to detach it from its basis without destroying the nasal bone, lest a very ungainly and suspicious-looking sinking in of the nose ensue. With a chisel and hammer I first made a vertical furrow into the tumor over the bridge of the nose; then I chiseled the left part of the growth off from the

bone, and, after this, the portion which extended into the left orbit. This done, I dealt in the same way with the right half of the tumor, taking care to carry the edge of the chisel accurately along the bony walls of the nose and orbit, and avoiding any breaking down of the normal bones. In some places the tumor, or rather the tumors (for there were virtually three), were so densely united to the underlying bone that the chisel made headway but very slowly, yet I was not discouraged, and continued hammering, by rapid and easy strokes, until one part after the other gave way, and, at last, the entire tumor was cleanly removed. As there was very little hæmorrhage, I united the whole wound with sutures. The operation required one hour and a half of uninterrupted labor. The patient felt no cerebral uneasiness whatever.

The parts which had covered the tumor were moderately swollen during the first days after the operation; some œdema of the eyelids also made its appearance, but soon disappeared. There was some suppuration in the right corner of the wound, but it gradually ceased, and, four weeks after the operation, the patient was discharged cured.

The *fourth case* which has come under my notice is that of a gentleman of Chicago. The tumor is on the outer, upper part of the orbit, about the size of a walnut, grows very slowly, is unconnected with cerebral disturbance, and resembles the preceding case in its physical symptoms. I saw the patient only once, and asked him to come again in the autumn. If he comes, I shall advise him to have the growth removed, according to the method adopted in the last two cases, which I just had the honor of relating.

The three tumors which I removed belonged to the ivory variety of exostosis, which, in the orbit, seems to be more frequent than any other. These growths have a basis more or less broad, and, at the beginning, seem to be flat. They grow on the periphery only, converting the connective tissue, which covers them like a thickened periosteal capsule, into bone-substance. In this way they develop into roundish tumors, whose bulk may be considerably larger than their basis, which is apt to form a kind of pedicle. The adhesion of these tumors to their basis is less firm than the consistence of their

substance, a very favorable condition for their removal. Their substance shows the most compact bone-structure, closely resembling ivory, presenting even concentric layers. Their connective-tissue capsule periosteum is always more or less thickened, and may contain mucoid cysts, which easily mislead the surgeon into a false diagnosis.

If these tumors are more or less pedunculated, they should be removed, which, it seems, can be done without insuperable obstacles. If they originate in the periphery of the orbit, they rarely seem to extend into the neighboring cavities, and, so soon as by their increase they endanger the eyeball, their removal is imperative; if, however, they originate in the posterior part of the roof of the orbit, they commonly extend into the cranial cavity, and endanger life. Should I again meet with a case in this locality, I should either leave it alone or try to enucleate it entire. This, I think, may be done in the following manner: Displace the eyeball as far as necessary to gain access to the growth, separate the periosteal covering from the accessible part of the tumor, then break down the neighboring bone—roof of the orbit—by means of a fine chisel and mallet, seize the tumor with a strong pair of forceps, and extract it by gentle movements in various directions, loosening, if necessary, its intracranial attachments with a blunt instrument. Such an operation, gentlemen, I believe, is not only feasible, but even tolerably safe, and, when an opportunity presents, I shall not shrink from it.

The chisel and mallet, to my mind, are the most appropriate instruments for removing orbital exostosis. Dr. H. B. Sands, who kindly assisted me in the last of the above-described operations, mentioned that the drill instrument, at present so extensively used by dentists, might, perhaps, be adopted with advantage in these operations, and I quite agree with him. The different kinds of saw which I have tried are rather inefficient, which will be easily understood if we consider the excessive hardness of these tumors.

After all, the secret of success in operating for ivory exostosis seems to be to attack the tumor at its base, and at no other point.

2. *Retention Tumors of the Neighboring Cavities.*—Re-

tention tumors in the nasal cavity, intruding into the orbit and displacing the eyeball, are very rare. A remarkable instance of this difficulty came under my care two and a half years ago.

A healthy-looking girl, of fourteen years of age, consulted me in March, 1874. A tumor, the size of a walnut, occupied the region of the inner, upper corner of the orbit, reaching downward a little below the ligamentum canthi internum. Its entire surface felt hard like bone, and was nodular. The tumor was utterly immovable, caused neither pain nor inflammation, but pushed the eye outward, and a little downward, without impairing the vision. She breathed through the left nostril without obstacle, and her voice had no nasal twang. The tumor had first been noticed three years previously, as a slight swelling, above the inner corner of the eye, had grown slowly at first, more rapidly during the last months, but had never been connected with pain, weakness of sight, or any other inconvenience. The disfigurement and the beginning protrusion of the eye caused her to seek relief. From the symptoms, I thought I had to deal with an exostosis similar to the second case above described.

I made a curved incision from the brow downward, terminating a little below the insertion of the ligamentum canthi internum. The incision exposed the tumor, the surface of which was bony and covered with periosteum, which I detached partly with the blade, partly with the sharp end of the handle of a scalpel. I could thus determine the rotundity and the posterior limit of the tumor. Placing a chisel on the base of the tumor, which receded a little from the inner, upper edge of the orbit, I began to detach it from the orbit wall. After a few strokes with the mallet, the chisel pierced the bone, and entered into a cavity, from which a stringy, muco-purulent substance escaped. On closer examination, the tumor proved to consist of a thin but uninterrupted bony shell containing muco-pus. The shell was now broken down and removed with chisel and bone forceps. The cavity was completely emptied by syringing with water, a part of which escaped through the nostril. The periosteum was drawn over the defect in the os planum, and, together with the skin of the

lid, united to the corresponding nasal edge of the wound. The lower part of the wound, however, was left ununited for the escape of the secretion.

The reaction was slight. Every day, on syringing, a moderate quantity of muco-pus was discharged. Soon the wound showed a strong tendency to close altogether; it was kept open first by a tent, then by the insertion of a style which she wore constantly for almost a year. It was removed twice daily, and the cavity syringed. As the discharge continued undiminished for two months, I injected irritant liquids: tincture of iodine, nitrate of silver, and, later, sulphate of zinc. Very slowly the discharge decreased in quantity, and when, about a year after the operation, it had assumed a mucous character, and had become very scant, I removed the style, the wound closed rapidly, and there has been no trace of a relapse. Several months after the operation, the soft parts, which had covered the tumor, remained swollen, but gradually they assumed their natural condition. The orbit and eye have been free from any alteration.

The location of the tumor, above and behind the ligamentum canthi internum, pointed to the ethmoid cells as the origin of the disease. The os planum was distended and pushed into the orbit. Retention tumors are more frequent in the maxillary sinus. They are distinguished from the above tumor by raising the floor of the orbit, displacing the eye upward, and commonly producing an intumescence in the mouth and nostril. Concerning the diagnosis of these retention tumors, certainty may be obtained by puncturing them with a trocar. Yet this is of little practical importance, since it is time enough to ascertain their nature during the operation. The *prognosis* of these tumors seems to be favorable. A large opening into the bony shell, or, better still, a more or less complete removal of the bony wall which intrudes into the orbit, is, I think, the appropriate operative procedure, of course, with preservation of the eyeball. The after-treatment may consist in simple cleaning of the cavity, and, if this does not arrest the morbid secretion, injections of irritant solutions, as in the above case, should be employed.

3. *Sarcoma and Chondroma of the Orbital Wall.*—The

soft or hardish growths that start from the periosteum of the orbit, especially on the upper part, are commonly difficult to deal with, and prove mostly of a malignant nature. They frequently grow from both sides of the bone; for instance, from the orbital and cranial sides of the horizontal process of the frontal bone. The diagnosis is difficult, since, even in intracranial extension, cerebral symptoms are very slow to appear; commonly, only when the disease has reached such an extent that it is impossible radically to remove it. With a view that we need not shrink from what may seem bold steps in the extirpation of such tumors, I beg to refer to a case in which I removed a part of the bony roof of the orbit, thus opening the cranial cavity, without unfavorable consequences.

A robust man, of thirty-two years of age, consulted me in November, 1875, with inward and downward exophthalmus on the right side. In the region of the lachrymal gland, a softish, slightly uneven tumor was felt, a little larger than a walnut. Its anterior limit reached the orbital margin; the posterior could not be felt. The tumor was immovably connected with the roof of the orbit. It had first been noticed four months previously, had slowly increased, causing neither pain nor impairment of sight. On examination, there was venous congestion and some œdematous opacity of the retina, but no choked disk. Sight almost normal; Tn; F. complete. The eyeball moved but a little upward and outward, but freely in every other direction. The patient was under observation three weeks, during which time a notable increase of the swelling and exophthalmus was noticed. From the locality which the tumor occupied, I thought I had to deal with a degeneration of the lachrymal gland, and proposed extirpation, to which the patient consented.

I made a curved incision along the superior and outer quarter of the orbital margin, dissected the lid and soft parts from the tumor, freeing this tumor as far backward as I could reach. I then passed the closed blades of a strong pair of curved scissors behind it and lifted it out, which could not be done without some force. The whole growth, apparently, was brought out. When I then introduced my finger to examine the orbit, I found that I had made a round hole in

its roof, about one and a half centimetre in diameter. The dura mater could be distinctly felt, and the soft, cerebral substance above it yielded readily. The hole was bordered by a rough, bony edge, the posterior and lower part of which was thickened. I suspected that this thickening was still a part of the tumor, but the patient, who had been exceedingly excited, and had vehemently struggled against the ether, looked so exhausted, that I was afraid of extending the operation any further. The bleeding soon ceased, and I united the wound. The reaction was very moderate: some sero-purulent discharge for a week; then the wound closed. There were no cerebral symptoms. The exophthalmus did not materially diminish, and after four weeks began to increase again. A local relapse was manifest, and made rapid progress, extending over the temple and part of the forehead. The patient, who had been discharged from the hospital two weeks after the operation, was readmitted four weeks later, with cerebral symptoms, a high degree of exophthalmus, more advanced retinal congestion, but scarcely any impairment of sight. His wife, on being informed of the unavoidably fatal issue, took him home, where he died a month later, about three months after the operation. No *post mortem*. The tumor was an ossifying enchondroma, springing from the periosteum, and destroying the bone.

The little reaction which followed the operation suggested to me the feasibility of removing the whole, or almost the whole, roof of the orbit. When, as in this case, once an aperture is made in the bone, and the finger detects a sound dura mater, which separates readily from the bone, the remainder of the roof of the orbit can be broken down with bone forceps, and removed. In this way a radical extirpation may be possible.

4. *Growths in the Neighboring Cavities of the Eye.*— Growths that occupy one or more of the cavities surrounding the orbit, and intrude into the orbit, constitute commonly very grave diseases. Their anatomical structure varies considerably. Fibrous, myxomatous, polypoid, sarcomatous, cartilaginous, osseous, adenoid, and carcinomatous tumors are liable to originate in either of these cavities. The maxillary

antrum, more frequently than any of the other cavities, is the seat of such growths. Only a few of them have come under my notice, two of which I beg leave to mention in particular.

Three years ago, a healthy-looking man, of about thirty-three years of age, consulted me on account of a considerable upward displacement of his left eye. His left cheek was somewhat swollen, the left nostril obstructed, and with the finger I felt a tumor on the floor of the orbit. The roof of the mouth showed no abnormity of configuration. The difficulty had been noticed for five or six months, and steadily grown worse. The interior of the eye showed venous congestion and œdema of the retina. There was no notable impairment of sight. I thought it was a polypoid or sarcomatous tumor, springing from the maxillary sinus, and extending into the nasal and orbital cavities. I asked Dr. H. B. Sands, of this city, if, in case he agreed with me, he would operate on the patient. He did so at the New York Ophthalmic and Aural Institute, where I had the opportunity of witnessing the operation and the after-treatment. Dr. Sands made an incision from the inner corner of the eye, along the nose, and through the upper lip. Then he detached all the soft parts covering the anterior surface of the left half of the superior maxilla. He opened the antrum from the canine fossa. It was filled with a softish substance, which extended into the orbit and nose. He removed it with different instruments, among which sharp scoops were the most efficient. The removal was as complete as the circumstances would admit of, yet there was no doubt that some of the growth in the upper, nasal passage could not be reached. The wound was closed, and healed very kindly. His eye resumed its normal position and function. There was an offensive discharge from the nose for four or six weeks; from that time the patient had no annoyance for eighteen months. Then he complained of headache, nausea, vomiting, dizziness, and other cerebral symptoms. He went to Germany, and took a "purifying vegetable drink" for six weeks. His cerebral symptoms disappeared. He returned to New York and presented himself, feeling well. I found his eye and orbit in good condition, yet his left nostril did not seem quite free. Nine months

later he returned, with a considerable growth in the left nostril and inner part of the left orbit. Dr. Sands removed this in a manner similar to that of the first time. The wound again healed kindly, and thus far, about four months after the operation, the patient has felt well. The tumor removed by the first operation was a *chondroma sarcomatosum*, that removed by the last operation looked hyaline, was softish, and consisted mainly of *hyaline cartilage in the state of very active* proliferation. A part of the tumor was *myxomatous.*

The second case was that of a Spanish gentleman of fifty-six years of age, who consulted me at the end of July of this year. During the last two years he had sixteen times been operated on for nasal and pharyngeal polypus, but the obstruction in his left nostril had increased, his cheek was swollen, and the left eye was pushed more and more forward. At the inner side of the left orbit, I could feel a softish tumor, which reached from the brow to the junction of the middle and outer thirds of the floor of the orbit, and extended from the edge into the cavity of the orbit more deeply than the exploring finger could ascertain. Sight was not impaired. There was venous congestion and œdema of the retina—no choked disk. I thought that a fibro-mucous, possibly a cartilaginous, growth had originated in the left nostril, destroyed the os planum, and entered the orbit, probably also the malar antrum. I was aware that the maxillary sinus is the most frequent starting-point of such tumors, yet the history of a naso-pharyngeal polyp, and the greater development of the growth on the inner than on the lower wall of the orbit, made me suppose that in this case the disease started from the nostril. As the tumor rapidly increased, and the exophthalmus was already of such a degree that perforation of the globe and expansion and ulceration of the pseudoplasm, outside the orbit, had to be expected in a short time, I advised the patient to have the whole growth removed. He consented, and, with the kind assistance of Dr. H. B. Sands, E. Gruening, A. Alt, Goodwillie, L. Elsberg, and Clinton Wagner, I performed the operation at the New York Ophthalmic and Aural Institute on the 1st of August, 1876. I began by making an incision

from the brow across the lachrymal region down through the cheek, about four lines under the lower margin of the orbit. I then laid the orbital part of the tumor bare, which was mainly done with scissors, under the guidance of my left forefinger. The eyeball was pushed toward the temple by an assistant. With a gouge, I detached the tumor from its bony basis, which reached to the end of the orbit. In doing this, I found that the inner and a part of the lower wall of the orbit were destroyed by the neoplasm, which completely filled the malar antrum and the posterior two-thirds of the nostril. To get access to the antrum I made another incision through the cheek along the left nostril, and opened the antrum from the orbit down to the fossa canina. The contents of the antrum were carefully emptied with gouges and scoops. Then I chiseled and broke away the ascending process of the superior maxilla, to obtain free access to the cavities of the left nostril. The growth filled the ethmoid cells, and the two upper nasal passages. I took away the entire left ethmoid bone, except the cribriform plate, and with gouges and scoops removed every particle of the tumor that I could feel. The septum narium was crowded toward the right side. It appeared free from the disease, and so did the anterior part of the left, lower, turbinated bone. After the naso-pharyngeal cavity had been cleansed from the base of the skull downward and backward, as far as my finger could detect any suspicious tissue, I opened the left frontal sinus, the lower wall of which seemed to have been encroached upon by the pseudoplasm. When I had scooped out some soft and very vascular tissue from the lower part of the frontal sinus, it seemed to me that the growth was as thoroughly removed as it could be done without endangering the patient's life. A radical extirpation in sound tissue appeared impossible, since it would have involved the cribriform membrane, and a considerable part of the adjacent cranial bones.

I closed the wound with sutures. The eye had not suffered, and immediately after the operation the patient could see with it as well as before. The operation lasted an hour and a half. At first, the patient was kept under the influence of ether, but, when the pharyngeal part of the growth

was removed, we allowed him to become conscious, lest the blood might run into the bronchi.

For some weeks there was a fetid discharge from the nostril, the upper lid drooped, and both lids and the conjunctiva were œdematous. The eye remained uninjured, and moved harmoniously with the other. The patient saw well with it, and there was no diplopia when he kept both eyes open. He had lost a moderate amount of blood during the operation, but none afterward. There was but a slight febrile reaction. The wound was cleansed by syringing it from the nostril with lukewarm water, to which a small quantity of carbolic acid was added. At the end of the third week the secretion began to decrease, and the breathing through the left nostril became easy. The patient left five weeks after the operation, in a satisfactory condition. The growth was a *myxo-carcinoma.*

Dr. Mathewson: Mr. President, with reference to the use of the dental lathe and drills, I may be permitted, perhaps, a few words. There was a case kindly referred to me by Dr. Loring last spring, the case of a bony growth, very hard, nearly filling the external auditory canal of the ear, and causing a good deal of pain, dizziness, vertigo, and other cerebral symptoms, so that it seemed desirable to make some effort to remove it, to relieve the pressure, and it occurred to me, as soon as I saw it, that the best method of attacking it would be with a dental lathe and drill, and this was successfully accomplished. I have forgotten the precise date, but some time in May, I think. The case was reported soon after in the New York Ophthalmological Society. The growth was exceedingly hard, and was very satisfactorily attacked by these drills attached to the lathe, the drills being held in the hand, first perforating with small size, and afterward attaching a larger and larger instrument, and finally the largest of these instruments, and making quite a satisfactory opening. I found that I could use them in making a boring with the end of the drill and then by lateral pressure, and my experience altogether was so satisfactory that I think it would be a very useful arrangement in attacking other bony growths. The growth was exceedingly hard, and I feel convinced it would have been a tedious operation, and one attended with much more danger

in operating by any hand-instrument. The rapid revolution makes it capable of lateral pressure with much less danger than with the direct pressure by the hand. The patient made a satisfactory recovery.

A CASE OF CHOKED DISK UNDER OBSERVATION THREE YEARS AND A HALF, WITHOUT CHANGE IN APPEARANCE OR PROGRESSIVE IMPAIRMENT OF VISION.

By ARTHUR MATHEWSON, M. D., Brooklyn, N. Y.

Wickem Powell, coachman, aged thirty-two, came to the Brooklyn Eye and Ear Hospital, March 3, 1873. The sight of the right eye had begun to fail eight years before, and had diminished till there was little more than perception of light. About a year before, he had become subject to sudden attacks of violent headache, accompanied by momentary loss of sight in the left eye, occurring several times a day, so that he was obliged to give up his occupation, which was then that of a car-driver. After a time, he noticed that the vision of this eye had become impaired, and especially at night.

On examination the lens of the right eye was found to have undergone partial cataractous degeneration, so that the details of the fundus could not be made out. In the left eye the media were perfectly clear, but the optic nerve presented the appearance of choked disk, or "Stauungspapille," being swollen and projecting with indistinct outline. The veins were less engorged and tortuous than is usual; the arteries not much changed in appearance; there were no hæmorrhagic patches on disk or retina; the vision was $\frac{2}{4}\frac{0}{0}$, and the field somewhat restricted, especially at the inner and upper quadrant.

He has been seen at intervals during the three and a half years that have elapsed since the first examination, and the ophthalmoscopic appearances have remained unchanged. The apex of the swollen disk is best seen by me with a $+\frac{1}{1}\frac{}{0}$ lens; there is a manifest hypermetropia of $\frac{1}{4}\frac{}{8}$; the vision is better than at the first examination, being $\frac{2}{2}\frac{0}{0}$, with a strong light, on September 10, 1876; field of vision unchanged; does not see well at night; he has been subject to violent headaches at intervals, ranging from a few days to six weeks, these attacks being accompanied or preceded by dizziness and sudden loss of muscular power, so that he is obliged to sit down for a time till the seizure

passes off; he sometimes falls, but does not lose his consciousness; there is no paralysis of any muscle, and no marked derangement of sensation, though he sometimes speaks of a slight feeling of numbness on the left side of head; there is no pain on percussion of the head; the taste, smell, and hearing are unaffected, though there is tinnitus in the right ear; his intellect is not impaired; he is at times troubled with nausea, but does not vomit; there is no history of syphilis or of injury; urine normal; his appearance is, as you see, that of a man in good general health, his complexion being, perhaps, overflorid;[1] he is able to follow the occupation of driving a carriage. I have regarded the case as one of tumor of the brain.

So far as my knowledge goes, no record exists of any case of choked disk so long under ophthalmoscopic observation without change in appearance, or progressive impairment of vision, and for this reason it is presented as an interesting addition to the history of this form of optic neuritis.

Note.—*December* 15, 1876. The history of Powell's case above narrated has a singular and interesting sequel. The second day after the burning of the Brooklyn Theatre, December 5, 1876, at which nearly three hundred lives were lost, Drs. Shepard and Segur, of Brooklyn, were requested by the coroner, Dr. Simms, to make some *post-mortem* examinations, in order, if possible, to determine the precise method of death, whether by suffocation or from burns. From among the great number of disfigured and unrecognizable remains with which the Morgue was crowded, the body of a man was taken at random for that purpose. On examining the brain, greatly to their surprise, they found a pedunculated cystic tumor about the size and shape of a human eye, lying in the left middle cranial fossa, to the outer side of the cavernous sinus. The dura mater was thin and eroded at the point where the cyst had evidently rested upon it, and thickened, and in a state of chronic inflammation around the eroded portion. The bone was roughened below the eroded portion of the dura mater. The point of attachment of the tumor it was found difficult to determine, as it had been cut away in removing the brain before the growth was noticed. The cyst was filled partly with a fluid of the consistence of the white of an egg, and partly with a cheesy mass. On microscopic examination both parts were found to contain abundant granular cells. The cyst-walls were thin and composed of loose fibrous tissue. My patient was among the missing, and the clew afforded by the accidental discovery of this tumor led to the identification of his remains, Dr. Simms and Dr. Shepard, who make the official *post mortems*, having been requested by me long before the fire to examine for brain-tumor in

[1] The patient was presented for examination at the Congress.

case his expected sudden death came to their knowledge. The identification was made complete and positive through the examination of the remnants of the clothing by his friends, and by other circumstances.

In connection with this case, and to illustrate for how long a time tumor of the brain may exist with the production of but comparatively slight general symptoms (aside from the impairment of vision), I may be permitted to mention in brief a case reported last winter, at a meeting of the New York Ophthalmological Society, with presentation of specimen: Mrs. P., of Brooklyn, aged forty-five, of full habit, and very florid complexion, consulted me in February, 1872, on account of almost total loss of vision in both eyes. I found marked engorgement of both optic papillæ. The first noticeable symptom had been sudden vertigo and momentary loss of sight, occurring a few months before. After this, the sight had gradually failed, but there was little other evidence of cerebral disturbance except occasional attacks of vertigo. There was no paralysis, no derangement of sensation, and no impairment of intellect. There were some dyspeptic symptoms, but otherwise her general health was good.

Tumor of the brain was diagnosticated. The case soon passed out of my hands, but, on January 17, 1876, I was called to attend her *post-mortem* examination. She had died suddenly on the morning of that day without apparent cause. According to the accounts of her friends, her condition was improving at the time of her death, the attacks of vertigo being less frequent and severe. Aside from the blindness, which continued, these attacks of vertigo were the only evidence of cerebral disturbance that was present in the course of the disease. A sarcomatous tumor, of the size of a large English walnut, was found in the anterior lobe of the right cerebral hemisphere, attached below to the dura mater, which was adherent to a sharp-pointed, osseous growth, extending upward from the orbital plate of the frontal bone.

There was a history of a severe fall, with injury of the right side of the forehead, some years before.

THE INTRODUCTION OF THE METER-MEASURE FOR THE DETERMINATION OF LENSES.

By Prof. A. NAGEL, of Tübingen.

When, in 1867, before the Ophthalmological Congress in Paris, the motion was made to introduce the meter-measure for the determination of glasses, instead of the different inch-measures so far in use, that body appointed a committee to examine this proposal, and eventually propose measures for its execution. This committee met with unexpected obstacles in its endeavors to solve the question; it was principally the war of 1870–'71 which prevented a final settlement. It was therefore impossible to lay a result before the Congress of London in 1872. Even to-day this cannot be done, in the strict sense of the word, as the committee, as such, has not had any occasion to exchange opinions on the subject, either verbally or in writing. Nevertheless, a perfect unity of opinion has established itself on the subject in question, not only among the individual members of the committee but also among ophthalmologists at large. The proposition which I sketched in 1867 before the Congress was this: To accept a lens of one-meter focus, to be called the meter-lens, as a base for a set of glasses and as a unit for their determination, and also correspondingly for the degrees of ametropia, and this proposal met with universal favor in the course of years. It seems that, after a long discussion of the reasons for or against the projects, carried on in the journals of Ophthalmology, the conviction has become general, that the principles on which it is founded are rational and to the purpose. Donders pronounced last year at the Ophthalmological meeting in Heidelberg in favor of the project formulated by me, and said, at the same time, that those members of the committee who had formerly been in favor of other solutions of the question had withdrawn their proposals, and declared their adhesion to the meter-lens project. The modification wished for by Donders, viz., that the halves and quarters of the unit of the meter-lens, when put in writing, ought to be expressed by decimals,

I at once adopted. The question then stands to-day as follows: There is only one project proposed, against which nobody raises any objection whatever, and the adoption and introduction of which have already begun. Lenses, sets of lenses, and refraction-ophthalmoscopes, have been carefully manufactured according to the principles of the meter-lens, and many oculists for more than a year have used them to their entire satisfaction. We see the meter-lens rapidly gaining ground in the scientific writings of ophthalmologists, and in the instruction at the universities. It would be desirable, and it is to be expected, that the International Ophthalmological Congress, before which the question was first brought up, and which took the first step toward reform, will choose its position and pronounce publicly on the subject. Such a joint declaration seems particularly necessary for those who are outside of ophthalmological circles, the manufacturers of and dealers in lenses, to see the adoption of the new lenses and their new determination accomplished, and make their speedy introduction into practice feasible. I have no instructions from the committee, but I believe I may be allowed to say that there exists to-day no further difference of opinion among its members, and I think I express the conviction of all in pronouncing the speedy introduction of the meter-measure into practice desirable and necessary. A declaration of opinion by the Congress, particularly if it should be unanimous and without opposition, would strongly promote the reform. It is not necessary to adopt a certain succession of lenses, because different successions and degrees will be necessary for different purposes; all that needs to be done is to establish this one principle, viz., that henceforth all lenses, spherical and cylindrical, shall in regard to their refraction be denominated in such a way that the lens of one meter focus (to be called "meter-lens," or if so desired Dioptrie) is taken as a unit, and the degrees of ametropia and astigmatism are denominated analogously, that means, according to the lenses by which they are optically corrected, the subdivisions of the unit to be designated in writing by decimals.

Experience has already taught us so far, that the manufacturers do not need any particular instructions. Intelligent

opticians have already satisfied the wishes of the oculists, and competition will do the rest.

Mr. Carter: I would like to mention that I think the Congress is already fully committed to the view taken by Dr. Nagel in this matter. At the meeting in London in 1872, a declaration was signed, I think unanimously, by the members of the Congress, signed I believe by every gentleman present and by many who came in afterward, pledging themselves to use a metric system of lenses for the future; and that was done in order to stimulate commercial activity in supplying these lenses. I had myself used metric lenses extensively in my own practice for four years previously, and thus I can speak from eight years' experience of the vast convenience of this metric system, in the way of facilitating work. In London, I may say, the change is fairly established, and I trust it will soon be universally so.

Dr. Knapp: This system is more or less unanimously adopted in Europe, and at the Congress in Heidelberg it was distinctly stated that no vote should be taken as to any obligation to adopt it; but the system should be brought forward as science does always, and then let everybody choose, and the result has been that it is fast making its way into general use.

The Congress then adjourned till 3 p. m.

Wednesday, September 13, *Afternoon Session.*

The Congress was called to order at 3 P. M., and the minutes of the morning session were read and adopted.

The President announced the first paper by Dr. Jeffries.

THE DETACHMENT OF POSTERIOR SYNECHIÆ.

By B. JOY JEFFRIES, M. D., Boston.

At the International Congress in London, in 1872, I had purposed, if time permitted, to make a few remarks on my method of detaching posterior synechiæ. It is, in reality, but a slight modification of Passavant's operation, but of some importance as enabling us to accomplish our object with more certainty, and less risk of danger to the eye. The four years which have elapsed have further shown me the practical bearing of this procedure, and convinced me of the difficulties with which we have to contend, and the reasons why this delicate but simple operation is not more resorted to by ophthalmic surgeons. These I would here briefly speak of, while again insisting on the advantages of operating as I now do.

Both the application and the value of iridectomy have been constantly misunderstood from the introduction of the operation to the present time. This has been very much the case with Passavant's operation. It has been used where iridectomy alone was in place, and hence discarded in another case where it would have been useful. As to synechiæ themselves, it must be remembered that a broad one, or several broad ones, are likely to be associated with such a stiffened and infiltrated condition of the iris that the muscular action can not, and does not, take place; hence such synechiæ are not so immedi-

ately irritating to the eye as the dragging the iris receives where two or three small ones exist, and muscular action is possible and constantly exerted in response to light and shade. But though broad synechiæ and an unyielding iris are not troublesome, or so especially dispose to another attack of iritis, yet, in just these cases, from fear of total closure of the pupil, does one feel inclined to interfere, and in these cases has Passavant's operation been employed instead of an iridectomy. Such cases, moreover, are more likely to come to us, and submit to operation, from the deformity of the pupil and the accompanying impaired vision due to slight capsular film. Cases where a patient has failed to apply early in iritis, or escaped the immediate use of atropine, and one or two slight synechiæ have resulted, are those most unlikely to submit to any operative interference. The patients have just suffered considerable pain, been more or less confined, prevented from using their eyes, and, from our continued use of atropine in hopes to break the synechiæ, deprived of their needed accommodation. While, also, the iris was kept still by atropine, the eye was not irritated, and our warnings as to the effect of the synechiæ not heeded till another attack, preceded by more or less trouble, confirms our prognosis. An attachment or two seem, moreover, so slight an affair as to make many surgeons shrink from operative interference from the fear of making matters worse. I cannot but think this is in great measure due to the precise method of performing it, namely, with a small iridectomy or lance-knife, and ordinary iridectomy forceps, as described by Passavant and many others following him. Now, I hold the modification I have employed renders the operation an entirely different affair, more often applicable and much freer of risk. As I have described in the "Transactions of the American Ophthalmological Society," some years since, the bent broad needle forms an opening large enough to manipulate the peculiar forceps in, and wholly prevents escape of aqueous till the latter are introduced. Moreover, the corneal opening, thus made, closes on the forceps so perfectly as to prevent the total loss of aqueous, and thus enables us to pass the forceps into the anterior chamber again, where we may have already made a second opening with the

needle, opposite another synechia. The necessary number of operations is thus much abridged. There is, of course, but very slight chance of the iris becoming entangled in the wound of a broad needle, unless we have deliberately pulled it in while withdrawing the forceps. The force required to break synechiæ (*which can and should be broken*) is very slight, and the traction scarcely perceptible to the fingers. If two synechiæ are not far apart, we may make our opening midway between them, and carry the forceps to one and then the other. I have no hesitation in puncturing the cornea two or three times, opposite as many synechiæ, as the needle, properly handled, allows of no escape of aqueous, and the forceps will glide against the cornea over the iris. The exact form of the instruments is of all importance. The point of the needle should be very much like that of a Graefe's cataract knife. Ordinary bent needles, or paracentesis needles, are not at all adapted for Passavant's operation, and much less an iridectomy knife, no matter how small or how sharp. The forceps, of course, are to have no teeth, and be only slightly roughened across the inside of the points, but for some little distance up. A still more important point is, that at least for one-third of an inch from the points they should close at once, in the act of shutting, thus allowing the points to separate sufficiently when the blades are in the wound. I must remark that I have seen forceps made especially for this operation, whose points would lie in contact while the blades were separated the whole width of the wound. The spring should be only strong enough to hold them between the fingers, as thus we shall better feel what force we are using, and we need but the slightest to tear away an iritic attachment to the capsule, which should be thus broken. The points should be most carefully rounded, so as to glide over the iris and not scratch the cornea. The capsule, of course, is never to be touched by the needle or forceps. These precautions, as to the operation and the instruments, will not seem trivial to any one who will follow up this prophylactic means of preventing recurrent iritis and final closure of the pupil, to be relieved only by an iridectomy. Passavant's operation is only in place where atropine and mercury fail to break iritic adhesions, and the former has proved the

muscular power of the iris to be present and free to act. I know of no objection to its use under these circumstances. I have not found it a difficult operation, done with the instruments I employ. It is a delicate operation, I admit. An ophthalmic surgeon who cannot perform it readily had better turn to rougher general surgery. Necker's remark about another operation will hold good here. I have performed it under ether, and under nitrous oxide, as also without any anæsthetic.

Finally, as to the harm posterior synechiæ do, and their tax on and irritation of the eye, I cannot but think my experience, since a naturally closer attention, shows me that precisely those cases which can be readily relieved by an operation are the ones which are most likely to give rise to irritative iritis. Rheumatic iritis will recur without synechiæ, but even a single iritic attachment is another, and not infrequently an exciting, cause of subsequent trouble. As to an operation, my advice is to have synechiæ broken as soon as we are sure mercury and atropine will not separate them. If the patient is to be away from the centres of ophthalmic surgery, I should feel that an operation ought to be insisted on, and I have, therefore, thus again briefly called attention to this procedure of Dr. Passavant, as modified, because I believe it has been neglected in consequence of misuse.

The next paper was then called.

THE OPTICAL ERROR OF CONICAL CORNEA, AND REPORT OF TWO CASES TREATED BY OPERATION.

By HENRY D. NOYES, M. D., New York.

It has been the prevailing belief that the form of refractive error which is caused by conicity of the cornea must be myopia. The increase of curve naturally suggests this idea. The irregularity of the refraction and the incorrectable character of a considerable part of the error have combined to induce ophthalmic surgeons to make little inquiry into the real

nature of the optical fault. It is true that some measurements have been made with the ophthalmometer, but these findings have not fructified into beneficial practice. In the "Transactions of the American Ophthalmological Society," for 1874, page 132, Dr. Thomson, of Philadelphia, records the examination of four cases of conical cornea, and finds that out of seven eyes five possessed mixed astigmatism, amounting to very high degree, one had compound myopic astigmatism, and one had simple hyperopic astigmatism. Vision equaled in two eyes $\frac{20}{32}$, in three eyes $\frac{20}{30}$, in two eyes $\frac{20}{40}$.

I have found the existence of hyperopia in certain meridians of conical cornea enough to render correction by the suitable cylinder extremely satisfactory.

The following case was relieved by giving a simple cylinder for one eye, and by trephining the cornea of the other:

Miss R. P., aged nineteen, of slight figure, weighing one hundred pounds, came to consult me in April, 1874. She began six months before to have pain in the eyes, and about six weeks ago the right was first discovered to be almost useless. In the right eye there is a conspicuous, though not extreme, degree of conical cornea. The apex is quite pointed. Viewed in profile, and illuminated by the mirror, two dark ovals are formed upon the cone, one being the pupil projected forward by refraction, and, in front of it, another smaller oval, caused by caustic refraction from the apex. When viewing the fundus, the pupil being enlarged, the vessels seen through the apex form circles, ellipses, etc., while the margin of the cornea is emmetropic. No effort was made to estimate the real value of the refraction in this eye, with $-\frac{1}{48}$ V. $=\frac{20}{200}$.

In the left eye there was no manifest alteration of the shape of the cornea. Examined under atropine by the ophthalmoscope, the vessels exhibited breaks in their continuity, as if seen through the edge of a prism, and showed that the refraction was irregular. The first trials with glasses could not secure any improvement in vision, which was $\frac{20}{70}$. Pain was distressing, and the use of atropine was continued for a month, but with no improvement of sight or special relief of pain. She used the syrup of the phosphate of iron, quinia, and strychnia. She possessed a remarkably placid and patient disposition.

In September, 1874, five months after first seeing her, finding she had no relief from pain, and that in the worse eye no valuable improvement of sight could be gotten either by glasses or by a stenopaic slit, I

trephined the right cornea. Drs. H. Althof and W. S. Little kindly assisted. The plug of cornea was only in part separated by the trephine, and its remaining attachments were severed by help of forceps and scissors. Six weeks afterward, Miss P. came to the office; the anterior chamber had in part been reëstablished, the hole was filled up by new tissue, the pupil adhered to the inner side of the opacity, which looks like a flat ulcer. There has been from the operation very little irritation; still wears a pad over the eye. Was allowed to go to her home in Pennsylvania.

A little more than three months afterward, I made iridectomy downward and inward. There was a circular opacity less than three millimetres in diameter, with well-defined edges, and surface perfectly smooth. Anterior synechia at upper and inner side.

In November, 1875, thirteen months after the trephining, found that, with + 12 c. 110°, V. = $\frac{20}{200}$.

In the other eye, a more searching examination brought to light the existence of simple hyperopic astigmatism, viz., +15 c. 180° V. = $\frac{20}{40}$ +.

I heard from her, in the following February, that she suffered no longer from pain, had great comfort with her glasses, and read a good deal.

Case II.—Conical cornea; mixed astigmatism; excision of apex; union by sutures.

Mr. J. K. C., aged twenty-six, a well-built, healthy man, who had lived on a farm, and within a few years had devoted himself to study, came to me in April, 1875. At eleven years of age he discovered that his sight for distance was imperfect; he could not see figures on the black-board in school. At seventeen years of age he began to have pain in his eyes, and light became troublesome. He then left school, but at twenty-one he resumed his studies and worked diligently. He found his vision growing worse, and eyes more painful. Was for a time under care of an oculist in Detroit.

There is an evident conicity of each cornea, and the summit of the cone is not central, but points downward, and is dotted over with minute opacities.

The refraction is as follows:

O. D. + 14 c. 15° — 2½ c. 105°.

O. S. + 5 c. 60° — 3½ c. 120°.

This result was found by atropia, and the use of the ophthalmoscope and astigmatic tests.

In the right eye the apex of the cone was myopic — 2. The

complicated formulæ which expressed the refractive errors were not attempted in glasses, being thought too difficult to construct, while with — 5 c. for each eye he attained O. D., V. = $\frac{20}{50}$ + ; O. S., V. = $\frac{20}{80}$.

For six months these glasses were worn, but the condition became worse. Vision fell off to O. D. $\frac{20}{80}$ and O. S. $\frac{20}{200}$.

I then deemed it wise to operate for the defect of the worse eye. Patient put under the influence of ether, which could not cause sufficient anæsthesia, and chloroform was substituted. With a very narrow knife the *left* cornea was transfixed a little below the centre, making a horizontal wound eight millimetres long; by forceps and scissors an oval strip was then cut out whose widest part measured two and a half millimetres. The cornea was found reduced to less than one-half its proper thickness. On escape of the aqueous, and contraction of the pupil, the lower edge of the wound corresponded to the margin of the pupil. The next step in the operation was not a little difficult of execution. It was to pass sutures through the edges of the wound and draw it together. I was led to attempt this unusual proceeding, for two reasons—one, the hope that the amount of synechia might be greatly restrained by closing the wound, and, second, the hope that the union would be more speedy. I was persuaded that the cornea would tolerate the presence of the sutures, because that had been tested by Dr. H. W. Williams, of Boston, in his employment of the suture after flap extraction. The needles were such as he devised—very fine and curved, and about one-third of an inch long. The sutures were made by unraveling an extremely fine silk thread, and using one of the three strands which composed it. The suture was so delicate as to be troublesome to handle. The sutures were entered first into the lower lip of the wound, and the difficulty of passing the needles through its upper lip was in a measure obviated by lifting up the edge with a blunt iris-hook, which was passed flatwise between the capsule of the lens and the cornea. The whole was an anxious proceeding, but, after patient effort, was safely accomplished, and two sutures introduced. The ends of the thread were cut short. The line of wound was just at the lower edge of the contracted pupil. It was impossible to employ an ordinary wire or spring speculum, because of the weight and pressure on the globe. The upper lid was retracted by the wire retracting-elevator, which I have devised. A bandage was applied and retained for three weeks constantly. There was no unpleasant reaction. At the end of three weeks the extremities of the wound had united, but the centre was open. The sutures remain *in situ*, have loosened, but are not causing irritation; they have especially lost hold upon the lower edge

of the wound. There has been a loss of epithelium from the edges of the wound. There has been no iritis; pupil is attached at its lower edge in the wound; the upper border is free; the anterior chamber is partially restored; no atropine used until the third week. On the twentieth day one suture was removed, and on the twenty-third the remaining.

The effect of removing the sutures was unfavorable. In two days the wound began to gape, and the iris prolapsed perceptibly. On the fourth day after removal of stitches, I punctured the projecting scar, and let off the aqueous humor. This was repeated daily for sixteen days. On December 28th vision before puncture was $\frac{20}{100}$, after puncture was $\frac{20}{60}$. This improvement depended in part upon the diminution of the pupil, and in part upon the improved form of the cornea. Could read Jaeger 7 at ten inches.

On January 13, 1876, the cicatrix had become firm, and the pupil was drawn into the tissue, so as to have only a small part of it above the scar. It would not yield to atropia. I thought it inevitable that a greater entanglement would occur, and, to avoid ill effects from the adhesions, made a small iridectomy upward.

The eye healed well, but the effect on vision was prejudicial. Tested two weeks after the iridectomy, the refraction was found + 4 c. 160° — 8 c. 70° V. = $\frac{20}{200}$.

This indicates that the horizontal meridian had been much flattened, while the vertical had been made convex. This was in marked contrast with the primary condition, when the meridian 120° was myopic 3½, and the meridian 60° was hyperopic + 5.

The ultimate result of the case is not yet known.

Comparing the two cases related, it is seen that to trephine is a better method of operating, for moderate degrees of deformity, than the use of sutures with an elliptical wound. No doubt, the greater size of the wound in the second case was a most important factor in the process. Without the use of sutures, the prolapse of iris would have been much greater, and their efficacy was demonstrated by the speedy production of union at the ends of the wound. There was not perfect coaptation of the whole wound, because the middle suture could not be introduced. For a case of extreme conicity, I think it advisable to employ sutures and the excision of an elliptical piece. My experience in this case showed that the great difficulty is to insert the middle suture

after those at the ends are in place. If the apex of the cone be either above or below the horizontal meridian, and it often is below it, the line of union can be brought opposite to the border of the pupil, and the capsule will in some degree be protected. A Tyrrell's iris-hook is the best instrument with which to raise the edge of the cornea, that it may be seized with very fine-toothed forceps, and then pass the needle. It is impossible not to go through the entire thickness of the cornea when it has been much attenuated. It is better to put in first the middle suture—to leave it untied, and to use it to lift the lips of the wound, as in a loop—and then to pass the remaining two sutures, not tying any, until all are entered. If a state of perfect quiescence by anæsthetics cannot be obtained, the operation will be impracticable, because it would be hazardous to use fixation forceps. It is better not to remove the sutures, even when they seem very loose, so long as they are not causing evident irritation. They afford support to the cicatrix, as the above case demonstrates, even when they appear to be of no service. It cannot be inferred from the fortunes of one case, how extensive, after this mode of treatment, would be the attachments of the iris to the cornea. After trephining, anterior synechia must inevitably occur. After excision and the use of sutures, the exactness of the coaptation will determine the degree of adhesion of the iris. I cannot doubt that so nice a fit is possible as to make this adhesion very small and unimportant. I have made but one experiment, and leave the matter to the judgment of further observations.

As to the amount of benefit possible by glasses, it is certain, from Dr. Thomson's experience and my own, that much more can be done than has been deemed practicable. The fact that hypermetropia, in a high degree, may exist in one meridian of conical cornea, was to me a veritable discovery, because, while Dr. Thomson had already perceived and made known the fact, I was not acquainted with it. The flattening of one meridian may, and often does, coincide with great convexity of another meridian, producing mixed astigmatism of extreme degree.

Moreover, there may be simple hyperopic astigmatism

without myopia. The ascertainment of the exact optical condition calls for much patience.

The most accurate method would be the ophthalmometer, providing the errors of the crystalline did not interfere. In ordinary practice, the observer will depend mainly upon the direct ophthalmoscopic method, with enlarged pupil. The test by radiating lines, illuminated by transmitted light, is one well suited to these cases. It is advisable in these cases to simplify the test-card by using two radii, diverging not more than twenty degrees, on either side of the centre, rather than confuse the patient by many lines. This is true in examining all cases of astigmatism, but especially important when so much of the error is of necessity irreducible. In this case, one need only use the spherical glasses until the refraction of the principal meridians is made out. Another hint that may aid examination is to employ a slit and to cover the middle with a plug of wax which will be a diaphragm to stop out the irregular refraction of the apex of the cone. The test by two holes in a disk, which is to be revolved before the eye, suggested by Dr. Thomson, will also be serviceable. It has the great advantage of simplicity, of stopping out the apex of the cone, and of presenting in the lamp or luminous spot, which the patient looks at, an object easily recognized. One must resort to all methods, to determine the refractive error in these cases.

It is eminently worth while to do this, because the need of glasses will exist after operating, and possibly the operation may be avoided entirely. The need of operating will be confined to the cases of progressive deformity, and no doubt the time for resorting to it may be much deferred.

The pain, of which patients complain, is to a great degree asthenopic or accommodative, and this will be greatly mitigated by proper glasses. In progressive cases, the pain must in some measure depend upon distention, as well as upon fatiguing efforts to see. It is certainly obligatory upon the physician to supply the best possible correction by glasses, both as a means of relief and as a measure for ascertaining whether the disease is progressive.

The value of atropia in these cases, I esteem negative. It may sometimes relieve accommodative pain, but it cannot

abate the refractive error so as to improve sight. It is important to the investigation, but not in therapeutics.

Dr. Thomson, of Philadelphia: Mr. President, since the report of the cases that Dr. Noyes has so kindly alluded to, I have seen two other cases of conical cornea in which the refraction has been highly hypermetropic. The details of the first one I am not able now to remember, since, perhaps, two years have passed; but the case that I saw last, some time last spring, is so nearly similar to the case alluded to by Dr. Noyes that the one might be taken for the other. It occurred in a young woman of twenty-two or twenty-three years of age. The conical cornea had then been in existence some years. In the left eye there was so marked an optical defect and so high a degree of conicity (as there was in one of the eyes of Dr. Noyes's patient) that I soon became discouraged. I fancied it would be impossible to correct such a degree of conicity by one glass. In the other case, she had suffered a good deal from asthenopia, and, of course, had very defective sight both for far and near objects, and she suffered the inconvenience of having a very limited field of view. After a great deal of patience and exhaustion of various methods of testing the eye, I was enabled to get her acuity of vision up to $\frac{20}{30}$ by means of a + 10 cylinder, with its axis nearly horizontal. Treated practically, the eye was corrected by a plus cylinder, disregarding the apex of the cone. The acuity was $\frac{20}{30}$, and she was able to read with great satisfaction. These cases all have one other symptom that Dr. Noyes has not alluded to, that is to say, monocular diplopia. The apex of the cone is usually pointing downward, and in this girl's case the refraction of the eye was such as to be corrected with a convex cylinder, but she had likewise monocular diplopia. When she undertook to look at an object she would see it distinctly, and below it there would be a blot. One other point which seems to me to be of interest. In a case that I reported two or three years ago, I had already then had my attention called to the almost constant existence of conus in connection with astigmatism, and I found, in one of the cases that I reported, the fundus perfectly normal after the acuity of vision had been brought up to a high degree, say perhaps $\frac{20}{30}$, and afterward it became

possible for me to see the fundus of the eye through the correcting-glasses with entire satisfaction. I think the physiological condition should be considered in these cases. When there is a high degree of conical cornea, it is fair to suppose that there had been no accommodative effort whatever, and in this case there was not only an absence of binocular vision, but there was also, perhaps, a power on his part to read type as it would appear to him, in such a way as would be almost confusing to any man with proper sight. He must have read at five inches through circles of dispersion. Therefore, I assume that there was monocular vision in his case, and that the eye was under no accommodative strain, because it was like a person with myopia, and that, therefore, one of the conditions that would be necessary to produce conicity was wanting. I would like to ask Dr. Noyes whether he found any disturbance in the fundus in the case that he has referred to.

Dr. Noyes: None whatever.

Dr. H. W. Williams, of Boston: Mr. President, I quite agree with Dr. Noyes in the point which he has raised as to the desirability of leaving the sutures in the cornea when it does not cause irritation, and it surely does not in my experience. I have seen cases in which the sutures had remained a long time, and in which they have been removed very carefully, and apparently without any trouble, and yet I have seen the ill effects of it afterward, the wound, which had been very well united, giving way to some slight extent, perhaps; and we know the lesion is a very delicate one in some cases. It seems to me, therefore, desirable, while the stitches are in place, to leave them until we are sure that the wound is entirely firm. In one instance, I know, the suture was left in the cornea seven weeks without its giving rise to any irritation whatever, although, as a rule, it finds its way out in the course of a week or ten days; but in this case it remained seven weeks, and caused no irritation whatever, so that there can be no doubt as regards the question of tolerance.

The next paper was then read by Dr. Loring.

OPHTHALMOSCOPES WITH THE METRIC SYSTEM.

By EDWARD G. LORING, M. D., New York.

Anticipating the adoption of the metric system, ophthalmoscopes have already appeared with the new notation. Some of them are what have been known and used for some years past in this country as combination instruments, in which two superimposed disks are used. There can be but little doubt as to the advantages, however, of a simple over a combination instrument, no matter how ingeniously this may be constructed.

A simple series of glasses, then, where every glass has its definite focal value, will, I think, be preferred by the majority of observers. To this end, all that would be necessary, to adapt the instrument now in use to the new system, would be to change the glasses ground on the old to those ground on the metric system. This would not be a matter of much expense, as all that would be required would be a new disk with the appropriate glasses.

Twenty-five perforations give as frequent and as small focal intervals as the human eye can detect through the ordinary ophthalmoscopic mirror. Indeed, I believe, if anything, this number is too many, not too few. I have, therefore, while keeping the form of the instrument as it formerly was, adopted the following series of glasses of the metric system. As the glasses are four millimetres in diameter, ample room is given for a sufficiently large hole in the mirror.

The progression of the series, as will be seen from Fig. 1, is as follows:

Convex. 0.—.5—1—1.5—2—2.5—3—4—5—6—7—9.
Concave. .5—1—1.5—2—2.5—3—4—5—6—7—9—13—18.

As + 9 corresponds to + $\frac{1}{4}$ of the old series, I have thought this a sufficiently strong glass for all possible purposes, as a hypermetropia of $\frac{1}{2}$ can be easily estimated by it. Should a stronger glass be required, an instrument with twenty-six perforations is made by Mr. Hunter, + 13 being added to the above series.

To those who do not wish to renounce at once the old system, or who would like to alter their present instruments

without the expense of a new disk, I would suggest that the number of one system should be engraved below that of the

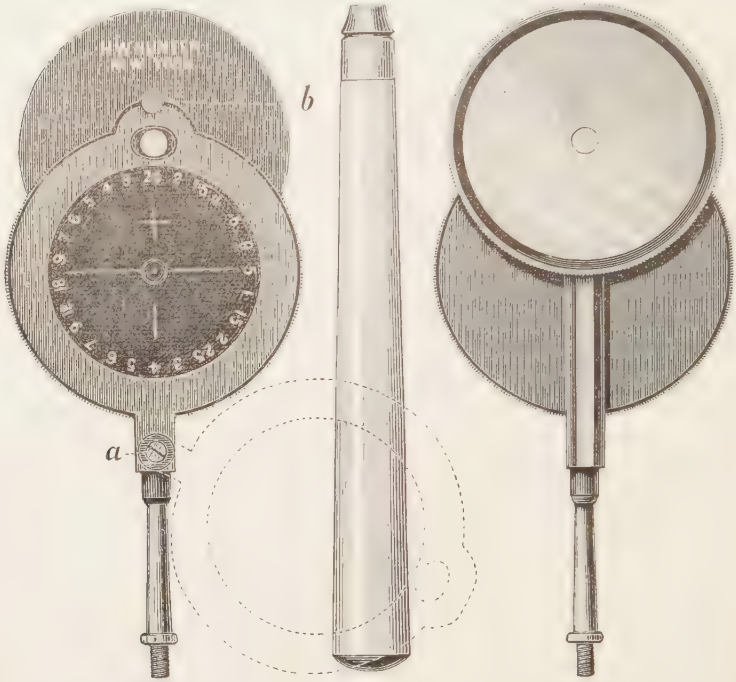


FIG. 1. FIG. 2.

corresponding number of the other. Then both systems would be given at a glance as seen in Fig. 3.

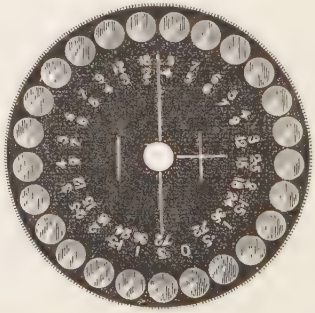


FIG. 3.

Should a combination ophthalmoscope be desired, the simplest way would be to use, instead of two disks, each of which

would require rather frequent changes, a clip behind the mirror provided with two glasses, each representing one-half a

Fig. 4.

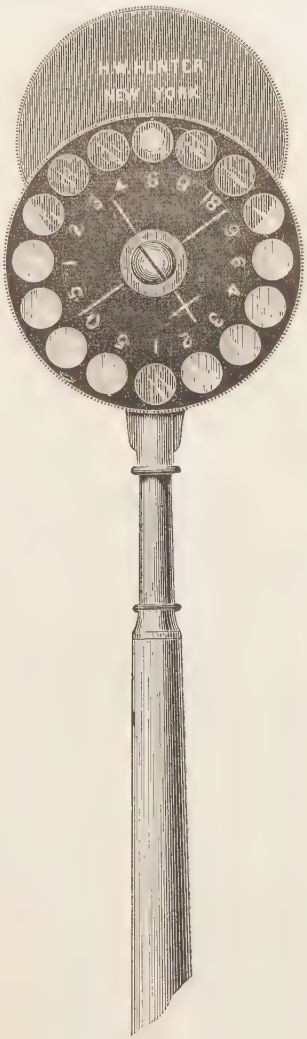


Fig. 5.

dioptric, thus +.5 and —.5. Without the clip, the regular series would then run 1.2.3.4, etc., according to the number of glasses used. With the clip, the intervening halves would

be denoted, and then we should obtain a series running, 1—1.5—2—2.5—3—3.5, etc. Fig. 4 represents such an instrument.

A larger instrument, precisely like this, but with sixteen perforations, has the following series of glasses:

Concave. 1—2—3—4—6—7—9—18.

Convex. 0.1—2—3—4—6—7—9.

The same instrument without any clip:

Concave. .5—1—2—3—4—6—9—18.

Convex. 0—.5—1—2—3—4—6—9.

To those who desire a still larger number of focal intervals, I would recommend that the instrument with twenty-five perforations (Fig. 1) should be modified in the following way: That the disk, as it now stands, should contain a regular series of whole numbers, and that a clip should be added with + and —.5

These instruments can be had of their maker, Mr. Hunter, 1132 Broadway, New York.

Note.—Since the Congress Dr. Wadsworth, of Boston, has made an ingenious and useful modification of my instrument. This consists of having fitted to it an additional mirror for the purposes of making examinations by the upright image, and especially for determining errors of refraction.

This additional mirror is very small, circular in shape, and has a diameter of only fifteen millimetres. On this account the hole in the mirror can be brought much closer to the glasses in the disk than in the ordinary Jaeger mirror, and yet an inclination be given to it of 20°, which is sufficient to avoid the astigmatism or distortion of the image by rotation of the glass on its vertical meridian. The mirror rotates from right to left, so that it can be used in the examination of either eye. This arrangement, however, necessitates the use of two mirrors, and their alternate adjustment for the inverted and direct methods. To avoid this necessity, and at the same time to get more light for the direct method and sufficient for the indirect, and also to obtain the advantages which the inclination of the mirror gives in the distinctness of the image, I have adopted the following modifications of the old mirror suggested by Dr. Wadsworth's mirror:

The first modification was to keep the general shape of the mirror as it now is, and to cut off a segment, as shown in the drawing, Fig. 6. The reflecting portion of the mirror is left plain in the drawing, while the shaded part shows the segment which has been taken away. This reflecting portion is swung on two pins, *a* and *b*, or made with a hinge at the point of juncture of the mirror and the mirror-case, that is, the part which

is shaded in the drawing, Figs. 6 and 7. When an inclination is needed, the mirror is tilted down into the case, and, as only ten degrees of pitch are required within the case, the one now used is sufficiently deep. Fig. 7 represents the mirror as seen in section. When used for the inverted im-

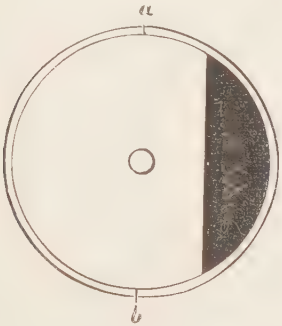


Fig. 6.

Fig. 7.

age, the mirror can be folded back, or, indeed, used just as it is. This like Jaeger's and Dr. Wadsworth's mirror, rotates from right to left. With this mirror we get abundant light for either method.

The second modification is still simpler, and consists of cutting off both sides of the ordinary mirror, thus converting it into a parallelogram, as seen in Fig. 8. This is swung, as before, on two pivots, the inclination, also, as before, being equal to 20°, or, if wanted, 25°. The mirror tilts both ways, and does not have to be rotated, and can be used perfectly well for either upright or inverted image. If more light is needed, this can

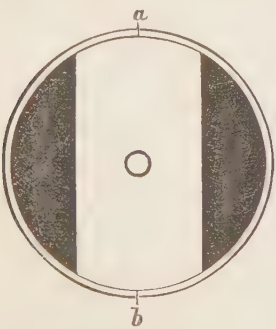


Fig. 8.

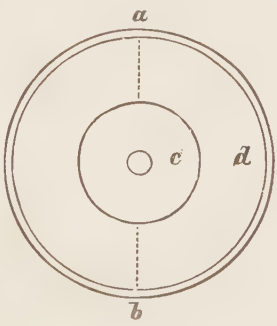


Fig. 9.

be obtained by making the shaded portions in the above drawings of mirror-glass. A still more elegant, though more costly, way of obtaining the same result is to have a small mirror, circular in shape, and swung on pinions *a* and *b*, for the central portion (Fig. 9, *c*), and this surrounded by a concentric mirror, *d*, so that the two together should form a mirror both

in size and shape like that now used in ordinary ophthalmoscopes. The external portion would, of course, be set stationary, the central portion tilting to the right or left, as occasion required. These mirrors can be fitted to any of the instruments made by Mr. Hunter, or, in fact, to any ophthalmoscope.

The next paper was also by Dr. Loring.

THE HALO ROUND THE MACULA LUTEA.

By EDWARD G. LORING, M. D., New York.

In the spring of 1871 I offered, before the Ophthalmological Society of New York, an explanation of the glittering ring seen round the macula lutea with the ophthalmoscope. The remarks and experiments then made were repeated before the American Ophthalmological Society, in July, 1871, with the hope that, it the demonstration was not correct in itself, it might lead to some further discussion of the subject. This hope has been realized finally in an interesting and elaborate paper by Dr. Brecht.[1]

In his remarks, Dr. Brecht has done me the honor to refer to my paper, but, in doing so, has been led, perhaps from the difficulties and obscurities of the language, into some fundamental errors, which, if uncorrected, might lead to a complete misunderstanding, not only as to the nature of the views and arguments which were advanced, but also as to the experiments by which they were corroborated.

These views, as briefly stated, were as follows:

"On looking at some drawings of the region of the macula, by Max Schultze, one of which I now reproduce in a diagrammatic form[2] (Taf. vi., Fig. 1), it occurred to me that the effect in question might be produced by the same causes within the eye that often produce it in other places in nature, or, in other words, that it might be the prod-

[1] Archiv für Ophth., Band 21, Ab. II., S. 1.

[2] The outlines and curvature of the different layers are fac-similes of Schultze's original drawing. The scale is here, however, reduced one-half; *p* represents the pigment epithelium, and *i* the nerve-fibre layer.

ucts of reflection and refraction from the combination of curved surfaces which enter into the construction of this portion of the retina."

Fig. 1.

"As you will see, this region, as figured in the diagram (Fig. 1), bears in its formation a strong resemblance to a shallow cup, of which the rim is represented by a convex, and the bowl by a concave surface. If we look upon these curved surfaces as mirrors, they would each have their foci, one lying behind, the other in front, according to their respective degrees of curvature. And if light should be thrown perpendicularly against such a combination of curves, the apex of the outside rim or convex surface would, from well-known optical laws, appear illuminated, while the inside or concave surface would appear more or less in shadow. Thus, we should have the effect of a darker centre, surrounded by an illuminated edge."

"In order to demonstrate this in its application to the retina, two *eye-phantoms* or cameras were made, precisely alike in every respect. At the bottom of one, a concave metal mirror, belonging to an ophthalmoscope, was placed to represent the retinal surface. Another mirror, precisely like the first, was then taken, and a very slight depression made in it by carefully pounding down the region immediately about the hole in the centre with a rounded chisel-handle. *As the implement was made of wood, a shallow indentation was made without cutting into the substance of the mirror.* This was placed at the bottom of the second camera, and represented, in a rough but sufficiently exact way, the cup-like cavity shown in the drawing, as belonging to the yellow spot. The two cameras were then examined with the ophthalmoscope."

"The first gave a perfectly distinct image of the mirror at its bottom, exactly as we should expect to see it, with the hole in the centre, with clearly-defined edges; but in the second camera the hole was surrounded by a brilliant circle, corresponding exactly to the limits of the depression, while the central portion seemed to be somewhat in

shadow. An idea, although a very rough one, of the effect can be formed from the following diagram, in which *A* represents the camera, in which the mirror had been left in its natural condition, and *B* the one in which the slight central depression had been made."

Fig. 2.

In commenting on these views, Dr. Brecht observes: "Loring seems to believe, and to get the idea from Max Schultze's drawing, that the retina, before it becomes reduced in thickness at the macula lutea, undergoes an increase in thickness, so that the macula is surrounded by a ridge, that is, a 'wall,' and by the experiment which he performed such a wall must be produced. But the drawing of Max Schultze, which he himself reproduces, does not show this wall."[1] This is very true. The drawing which I took the pains to reproduce in fac-simile does not show this "wall," neither did I suppose that any such wall existed, nor is there any such word, either expressed or implied, in the whole of my paper. On the contrary, the word used is precisely the opposite, that is, "depression," as a reference to the above extract, as well as to the whole of the original, will readily show. In point of fact, however, the retina does show a gradual increase in thickness, just before it decreases in thickness to form the macula. Nor can I admit that "such a wall will necessarily be produced by the manner in which the experiment was performed." Great care was taken to avoid this, and the method employed necessarily prevented such a result. For it must be remembered that the mirror was made, as such mirrors usually are, of comparatively soft metal, and was excavated

[1] Archiv für Ophth., Band 21, Ab. II., S. 1, pp. 14, 15.

at the back so as to give a sharp edge to the hole for the purpose of avoiding reflections from the edges of the canal. On this account, very little force was necessary to depress the region immediately surrounding the hole. The implement used was not of "iron," as asserted by Dr. Brecht, but, as mentioned in the above extract, of *wood*, and the "schlag" consisted of a gentle tapping, the edges of the mirror resting on supports, the centre being free. It was shown, to the satisfaction of the members of the two societies already mentioned, and, since the publication of Dr. Brecht's paper, a second time to the New York Ophthalmological Society, that there was no elevation in the shape of a wall, but that one curved surface, that representing the general retina, passed into the other, that representing the region of the macula, in precisely the same manner as they did in Schultze's drawing —a fact which you can convince yourself of by looking at the original mirror which I now produce.

Dr. Brecht then remarks that "this mirror was then inclosed in a wooden cylinder which was open in front, and which, consequently, was without an exact spherical curve, that is, without an emmetropic system of lens and cornea." Dr. Brecht continues by saying: "Loring *did not take the precaution to see that there should be, in front of the place of stronger curvature, at the posterior pole, a spherical apparatus with refracting surfaces, the nodal point of which lies in front of the centre of curvature of the sphere.*"[1]

This is underlined to render it more emphatic, and it would certainly have been a grave oversight on my part, if the statement were correct. This, however, is not the case, as the apparatus was not, as asserted by Dr. Brecht, an open capsule or cylinder, but an "emmetropic system, the nodal point of which *did* lie in front of the centre of curvature of the sphere." Moreover, it is expressly stated, in the paper to which Dr. Brecht refers, and in the extract above given, that, "in order to demonstrate this in its application to the retina, two *eye-phantoms* were made precisely alike in every respect." I am, therefore, a little at a loss to understand how so fundamental a mistake could have been made by any one who had

[1] *Loc. cit.*, p. 15.

taken the trouble to read the original paper, from which such copious extracts had been taken. I am all the more so, as the word "*eye-phantom*," though execrable English, is, I believe, good German. At any rate, the learned author uses it.

I feel myself compelled to allude to this, more particularly since Dr. Knapp, who twice saw the experiments, and who took part in the discussion which followed, has omitted, in rather an elaborate review of Dr. Brecht's paper, to correct these obvious mistakes.

In this connection, I would say that the phantom or artificial eye, which I use on this occasion, is the same which I showed before the American Ophthalmological Society in 1873. It is a representation of Donders' reduced eye, with a cornea ground on a radius of five millimetres with parallel surfaces, the media being represented by water. The instrument is, in all its principles, precisely like the one recently described by Prof. Landolt.[1] Every degree of refraction can be expressed upon it from H $\frac{1}{12}$ to M $\frac{1}{12}$, the increase and decrease of the antero-posterior axis being noted in the metric system. It is also fitted with a compound dioptric system of lens and cornea, as well as with a cornea representing the aphakial eye. No description of the instrument was ever published, though it has been found very useful, both by myself and others, for the past three or four years, in demonstrating to students every possible phase of dioptrics.

Misconceiving, then, both the nature of the views advanced and the experiments employed in their demonstration, Dr. Brecht goes on to remark that, even were the conditions in regard to the curves present, as assumed in my paper, we should with the inverted image "obtain at the very most only a quadrant of the circle, and never even approaching the whole, or even the half of the phenomenon, and just as little could the superficial glittering of the polar zone be explained."[2]

Passing over, without comment, this direct denial of a result claimed by me and shown to many others, I have only to

[1] *Klin. Monatsblätter*, July and August, 1876, p. 243.

[2] *Loc. cit.*, p. 16.

say that, if the conditions of the curves, as represented in Schultze's diagram, where there is no wall, and as taken in my experiment, are imitated with any pretension to accuracy, even if it be in the rudest manner, not only a quarter and a half, but the entire extent of the glittering circle will be reproduced every time without fail.

To account for the glittering ring, Dr. Brecht assumes that "there *must be a depression at the region of the macula.*"

The force with which this conclusion is emphasized, and the massive type in which it is printed, would lead one to suppose that the idea that there was a depression (*eine Einbiegung*) at this part of the retina was here suggested for the first time as an anatomical possibility, when precisely the same conclusion was brought forward in my paper some five years ago, where an attempt is made to show that there is "a depression of the entire region of the macula, notwithstanding the fact that Henle distinctly states that the only depression in the whole surface of the retina is just at the fovea itself." It was further argued that "this depression might exist in the living, even if it escaped detection by the microscope in the dead eye, and that "the ophthalmoscope should have a voice in explaining a phenomenon which is in strict accordance with physical laws, and which, outside of the eye, can only be so explained." Further, it was assumed, in precisely the same way as it was five years later, by Dr. Brecht, without the slightest acknowledgment, that this depression might be the result of the peculiar arrangement of the nerve-fibre layer "for, bearing in mind that, at the macula lutea, the nerve-fibre layer ceases to exist as such, and that the nerve-fibres make a peculiar bend here, it occurred to me that a difference in level might be occasioned, which, varying in different cases, might still be sufficiently marked in many eyes to give the effect in question." To show, in this connection, how slight an inequality in surface would produce the halo, an experiment was made, which I will not consume time to relate, referring the reader to my former paper. I would, however, remark that the perforation in the piece of tin-foil was not made, as Dr. Brecht asserts, "with a needle, from which a wall must inevitably result," but with an exceedingly sharp

tool, which left a perfectly clean-cut perforation. Over this, a second piece of foil was laid, the centre of which, by gentle rubbing, was pressed into the perforation of the first. Thus, a very slight "depression" was formed. The conclusion drawn from the experiment was that, in the nerve-layer *alone*, there would be thickness of tissue enough to more than produce the effect.

There is no reference whatever to this conclusion in Dr. Brecht's paper, and the only reference to the experiment is to misstate it.

As Dr. Brecht's views are essential for the correct understanding of what is to follow, I will give a brief recapitulation of them, borrowing, so far as is necessary, his own illustrations, one of which (Fig. 3) is slightly altered for the sake of simplicity.

Let *a* be a ray passing through the nodal point *k*, and striking the retina at *b*. The dotted line *b o* being the per-

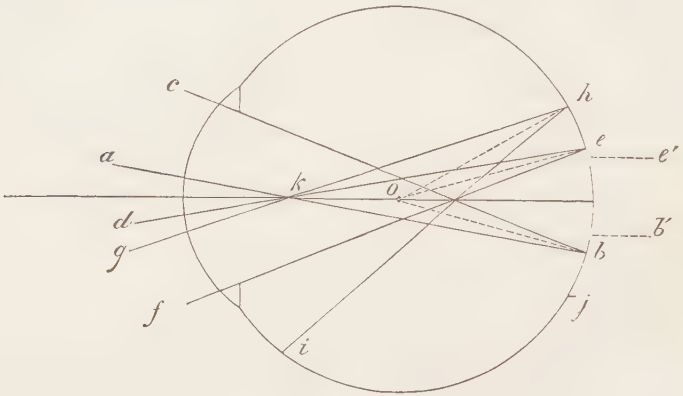


Fig. 3.

pendicular, the ray is reflected in the direction *b c* passing through the pupil out of the eye. Let *d* be a similar ray striking the retina at *e*, this will be reflected so as to leave the eye in the direction *e f*. All rays, therefore, striking the retina inside of the points *e b* would be so reflected as to leave the eye, and, seen by an observer, would give the appearance of a glittering surface at the posterior pole of the eye. Rays, however, entering the observed eye at a greater

angle with its axis than *a* or *d*, for example, *g*, would be reflected at such an angle that they could not escape from the eye, as at *i*. The glittering circle would, therefore, be limited to those rays which could leave the eye, and would be directly dependent both in form and size on the extent of the pupil, that is, the larger the pupil the larger the brilliant surface, and *vice versa*. But, although this regular reflection would therefore be limited in the figure to the space between *e* and *b*, rays would leave the eye by irregular reflection beyond these limits, say to *h* and *j*. It is by these rays that we get the ophthalmoscopic picture. Thus, we should see the glittering and circular surface, or, as Brecht speaks of it, zone, surrounded by the red reflex of the choroid, as represented in Fig. 4, in which the white centre represents the glittering surface at the pole, and the shaded outer ring the choroid.

Fig. 4.

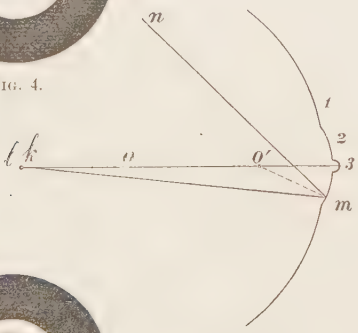


Fig. 5.

Fig. 6.

This would be the condition in a normal eye, if the retina extended in an uninterrupted curve, but it is assumed by Dr. Brecht, as it was earlier by me, that this is not the case, but

that a portion of the retina which surrounds the posterior pole, that is, the region of the macula, is constructed on a shorter curve. This region in Fig. 3 may be considered as extending between the dotted lines *e'* and *b'*. The increased curvature of this region is shown in Fig. 5. If, now, a ray, *l* (Fig. 5), passing through *k*, strikes the stronger curvature at *m*, this will be reflected at an equal angle with the perpendicular *o' m*, and would proceed in the direction *m n*. This ray could not, therefore, escape from the eye, and it would be the same with all regularly reflected rays falling within the greater curvature, or within the space denoted in Fig. 2 by the dotted lines *e'* and *b'*, except a very few rays, which, on entering the eye, run parallel with the axis and impinge on the retina in the immediate vicinity of the pole. Consequently, all that would remain of the former glittering circle would be what was included between *e* and *e'*, and *b* and *b'*, that is, a narrow ring as seen on full-view in Fig. 6.

If, then, both Dr. Brecht and I believe the glittering halo round the macula lutea to be occasioned by a depression of this region, in what consists the difference of our views? It would appear to be simply this: Dr. Brecht derives the want of reflex within the region of the macula lutea from there being a greater curve here, and the presence of the glittering ring from what remains of the glittering area formed by regular reflection at the posterior pole of the eye after the region of the macula has been subtracted from it, while I, attributing in some degree at least the want of reflex in the macula to the same cause, derive the *presence* of the ring from the passing of one curve, that of the general retina, into another and stronger curve, that of the macula, the peripherical part of this curve being convex, as in Fig. 1. In Dr. Brecht's explanation and drawings, the two curves join each other with sharp edges, in mine with rounded edges, the curves passing, as Dr. Brecht himself says they do in nature, into each other, not suddenly but gradually. This, then, in brief, is Dr. Brecht's explanation of the glittering ring seen round the region of the macula lutea itself. It is well, too, to bear in mind that this refers solely to the boundary of the yellow spot, and not to the reflex from the fovea itself.

Against his views would seem to be the following facts: In the first place, the shape of the outer border of the ring is oval, not round, as it would inevitably have to be if its limits were prescribed by the pupil. It is true that the outside contour is often broken by irregularly extending streaks of brilliancy, but with a little care its oval shape can be invariably traced. This objection Dr. Brecht recognizes himself, and acknowledges that he cannot account for it. To me it seems fatal to the entire theory.

I have repeated Dr. Brecht's experiments, and get precisely the same result that he does. The phantom which I use for the present demonstration is the aphakial eye, with a cornea of seven millimetres radius, and a focal length of twenty-eight millimetres, or almost exactly one French inch. The media are represented by water. The retina is a thin disk of glass ground on a radius of fourteen millimetres, with parallel surfaces, the inside surface being polished, and the external left unpolished; that is, with a surface of ground glass, upon which is attached the red surface representing the choroid. At the posterior pole a shallow excavation is ground on a radius, which bears to that of the general retina the proportion taken by Dr. Brecht, that is, as seven is to eight. The diameter of this excavation is three millimetres, and represents the region of the yellow spot.

On looking at the phantom we get precisely, as Dr. Brecht says, an illuminated ring surrounding the region of greater curvature at the pole of the eye. But, while I admit the presence of this ring, I cannot agree with Dr. Brecht as to the cause of its presence, and feel convinced in my own mind, as you will, I think, also, that it is precisely what Dr. Brecht believes it not to be, that is, the image of the ophthalmoscope. If we use, as Dr. Brecht so strenuously advises, a fixed ophthalmoscope, then the appearance does, indeed, resemble, to some degree, at least, the illuminated circle round the macula, simply because it is stationary; but, if we use the ordinary hand-ophthalmoscope, and turn it gradually on its vertical axis, so that its light shall fall not exactly on the place of strongest curvature, but just to the side of it, we see that *pari passu* the ring fades away from the non-illuminated side,

and increases in breadth on the other side till it assumes the perfect but somewhat distorted image of the ophthalmoscopic mirror with the hole in its centre. The centre of the image will, of course, be wanting where the rays which should form it fall on the place of stronger curvature. Thus, we should get a brilliant ring as the image of the outer portions of the ophthalmoscope. If we try the experiment on a retina which has an uninterrupted curve, we get the image *in toto*, including the hole in the mirror. But we have no occasion to change the retina to make this perfectly apparent. You will notice that inside of the illuminated ring, which surrounds the place of stronger curvature, is a perfectly distinct but reduced image of the mirror of the ophthalmoscope, every detail being perfect. This image is erect, for, if we place a small bit of paper, or, as in the present instance, a bit of wax, just above the hole of the mirror, you will see that in the image within the phantom the deficiency is also in the same place.

If there was now a second place of stronger curvature in the centre of the first, as in Fig. 5, and as Dr. Brecht has made it in his phantom, then we should have a loss of the centre of the second image, and we should get two rings, which is precisely what Dr. Brecht declares he did get, and which at first inclined him to think that the theory was erroneous. This he, however, reconciled later, from the fact that he discovered the presence of two rings in the living eye.

The explanation of these images of the mirror of the ophthalmoscope is, I take it, as follows: The distance of the lamp from the mirror is on the average twenty-four inches. The two-inch object-glass lies sixteen inches from the mirror and two in front of the observed eye. With these conditions, the image of the source of light, if we use the ordinary seven-inch mirror, would be at ten inches from the mirror, where they would cross six inches in front of the two-inch object-glass. By this they would again be refracted so as to meet behind it at a distance equal to three inches, $\frac{1}{2} - \frac{1}{6}$. Being intercepted by the observed eye, which is two inches from the glass, they would be rendered still more convergent, and cross in the vitreous, where a second image would be formed. But, besides this image of the source of light, which is that produced by

regular reflection, rays coming from the lamp will be reflected from the mirror by irregular reflection, as if this were the source of light. These rays would, therefore, fall upon the two-inch lens as if they diverged from sixteen inches, and would be brought to a focus behind this at a distance equal to 2.3 inches, $\frac{1}{2} - \frac{1}{16}$, that is, somewhere in the anterior chamber, where an inverted image of the mirror of the ophthalmo-

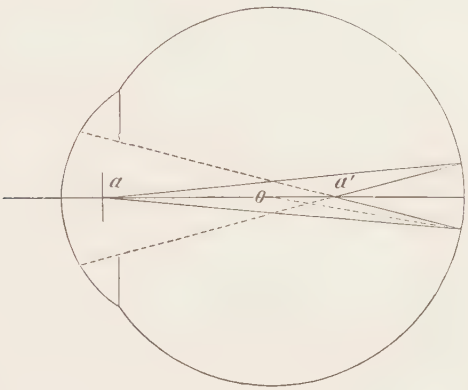


Fig. 7.

scope would be formed (Fig. 7, *a*). Rays diverging again from this would strike on the concave surface of the retina, and, as the object *a* (that is, the image in the anterior chamber) is outside of the centre of curvature of the retina, the rays will be rendered convergent and cross each other in front of the retina, where a second image of the mirror will be formed at *a'*, inverted as to that in the anterior chamber, but upright as to that of the actual ophthalmoscope. As the retina in the case taken by Dr. Brecht is made of glass, the index of refraction of which is so much greater than water, the image will be of great brilliancy. Applying this to the retina taken by Dr. Brecht (*see* Fig. 5), we get the following result: There would be an image formed in the vitreous by the concave surface of the general retina marked in Fig. 5 as Number 1, another from the surface of increased curvature representing the region of the macula marked 2, and still another from the surface representing the fovea marked in the figure as 3, since all of these surfaces are, in fact, concave mirrors.

As the reflecting surface is incomplete, that is, of a different curvature, in the first two, the images will be incomplete and will represent rings, an inner and an outer, as shown in Fig. 6. As the third surface or mirror is complete, the image will be complete, but exceedingly reduced in size from the strength of its curvature. Thus, we should get two concentric rings with a central light spot (Fig. 6), and this is precisely what Brecht got from his phantom. I cannot, therefore, help thinking that Dr. Brecht will convince himself that these rings are the remains of the image of the ophthalmoscope, if he repeats his experiment, taking care to imitate the proportions of the human eye as closely as is possible, and then, moreover, to use a hand-ophthalmoscope instead of a stationary or fixed instrument. That this is also according to geometric drawing, I think, he will find to be the case, if he makes the radii of curvatures the same on paper as he does in his phantom.

In his phantom he makes the radius of curvature of the general retina equal to one inch, and the radius of the region of the yellow spot equal to seven-eighths of an inch.[1] In his geometric drawing, while he keeps the radius of the general retina the same, that is, one inch, he makes the radius of the macula one-third of an inch, the proportion being in the first case as seven is to eight, and in the latter as one to three. (*See* Fig. 2, in Dr. Brecht's paper.) Had the curvature been constructed in the drawing, as Dr. Brecht claims it was in his phantom, the rays would then have issued from the pupil, and this would have spoiled his theory, which demands that the rays striking upon this part of the retina should be so reflected that they could not issue from the eye. Hence the change.

Nor do I think that the conditions which Dr. Brecht has chosen are those which ever obtain in the ordinary ophthalmoscopic examination. Thus, he places his lamp at only fifteen inches from his mirror, which is six inches focal length. The eye of the observer is at seven and a half inches in front of the object-glass, which is of two inches focal length, and two inches in front of the observed eye. The image of the source of light is thus formed in the air in front of the cornea,

[1] *Loc. cit.*, p. 18.

and not as in the ordinary examination in the vitreous. The inverted aërial image would then be at only five inches from the observer's eye. Such conditions as these are certainly not those of an ordinary examination.

But it may be objected that, even if the curves pass into each other so that a convex curve is formed, as shown in Fig. 1, it does not follow that the reflex comes from this portion of the curve, and not from the concave portion of the general retina immediately surrounding the macula, as claimed by Dr. Brecht. To determine this, the following experiment was adopted, in which all the conditions were kept in regard to the phantom, excepting that the posterior part of the retina was taken as a convex instead of a concave surface. This was done by using a wooden form resembling a plano-convex lens, the convex surface representing the surface of the retina. In the centre of the form a shallow excavation was then turned out on a lathe, the edges being rounded off so that the convex surface of the general retina passed over with a gentle curve into the concave surface of the excavation representing the yellow spot, as seen in the drawing, Fig. 8.

This form was then covered with tin-foil of a dull polish, such as dentists use, which on being gently rubbed moulded itself over the form.

It might be objected here that a metallic surface was used, which has a greater reflecting capacity than the retina. My reason for this is, that we do get a brilliant silver glitter, both around the macula and along the vessels, which resembles a metallic lustre more than anything else. Glass is too homogeneous, and of too great an evenness of surface, to produce the effect well.

On viewing this retina in the phantom, you will see that there is no regular reflection from the retina visible, no image of the ophthalmoscope or source of illumination, but that the illuminated ring comes out very brilliantly in its *entire* extent.

The explanation of this would appear to be as follows :

The rays *a b*, and *c d*, passing through *k* (Fig. 8), and striking against the convex surface at *b* and *d*, are reflected in such a direction that they cannot escape from the eye, as the angle

which they form with the perpendicular of the convex surface, that is, the radius *o*, is too great to allow these rays to pass the

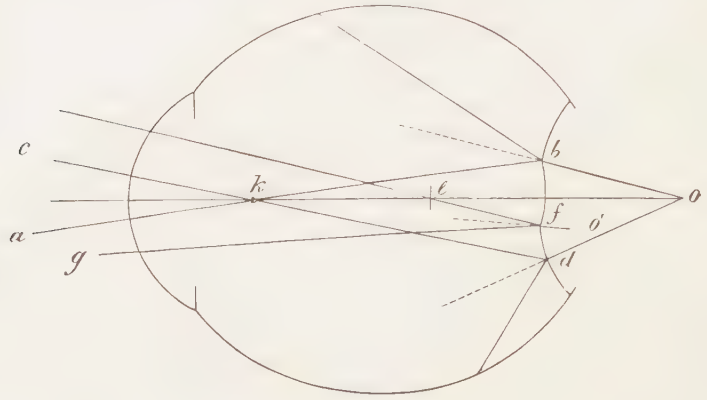


Fig. 8.

pupil. In the drawing, the line *a b* is represented as striking at the very limit of the convex surface, where it passes over into the concave surface of the yellow spot. The ray *c d* strikes, however, at a considerable distance from this point. It is evident that no rays regularly reflected can leave the eye from any part of the convex surface, which represents the surface of the general retina. But, if we suppose that *e* represents the image of the source of light in the vitreous, then a ray, after crossing, such as *e f*, and striking upon the apex of the curve, which connects the convex surface of the general retina with the concave surface of the yellow spot, would be reflected away from the perpendicular *o'* (the radius of the connecting curve), and leave the eye as *f g*. Further, since *e*, the image of the flame in the vitreous, is inside of the centre of curvature of the excavation which represents the yellow spot, the rays [1] striking upon this will be reflected as divergent, and at such an angle that they cannot escape from the pupil with the exception of a very few running parallel, or very nearly so, with the axis.

This shows conclusively that what Dr. Brecht denies, can

[1] These rays are omitted in the drawing to avoid confusion.

take place, and that the entire ring can be produced independently of the concave surface of the retina.

That there is a considerable amount of irregularity of the surface of the retina in young children, and especially in the neighborhood of the macula, follows, I think, from the irregular reflection which seems at times to play over and around this region. This, I cannot help thinking, is due to the projection of small vessels which ramify so thickly in this region, as has already been pointed out, notwithstanding the general opinion that this region is devoid of vessels. Schirmer supposed that the halo was due to reflection from the walls of some vessels which encircled the macula, and if it could be shown that a vessel or two vessels did surround this region, and that they projected as retinal vessels often do above the surface of the membrane, the effect might readily come from them. This is easily shown by a very simple experiment. If we take a *very* fine piece of silver wire and make a ring of it, and, placing it upon a small disk, cover both with the tin-foil already described, we shall then obtain a general surface with a ring projecting to a small degree above the general level. If this is now viewed with the ophthalmoscope in the phantom, we get a brilliant reflex from the entire extent of the crest of the elevation, resembling to a considerable degree the reflex seen in the human eye. This is, of course, on the same principle that has already been laid down. Still, the exact representation of the ellipse and the comparatively sharp-cut inner and outer border of the halo are against such a view.

I cannot in this connection agree with Dr. Brecht's statement, that we never see a glittering reflection on both sides of a vessel, as I have myself repeatedly seen it.

In regard to the statement that no other author has ever remarked upon the reflection that occurs from the curve formed by the passing of the curve of the fovea into the surrounding region, I would say that it is stated in my former paper that "the shape of the reflex (of the fovea with the upright image) is just such as would come from a narrow-mouthed pit, for, while one side was turned so as to catch the light and reflect it, the other edge would be turned so that no reflex would come back from it; consequently, we should have a crescent or

half-moon shaped reflex, changing its position, as it really does, with every movement of the eye," etc.

I have occasionally seen what appeared to be a minute spot or star of light from the fovea with the inverted image, but I have certainly never seen the two rings and the central spot all at once, with the inverted image, as described by Dr. Brecht. There is no reason, however, why this should not occur, and be explained as rationally by the theory advanced in my former paper as by that advanced by Dr. Brecht.

It has been stated by many authors that it is very curious that we never see the halo with the upright image. I believe the cause of this to be due to the facts mentioned in my earlier remarks, that is, that the enlargement of the upright image is too great, and the illumination different as to force and direction, to obtain the effect. I had, however, mentioned there that, occasionally, I had observed a segment of the circle playing about the position in which the boundary-line of the macula should be. Since then, I was informed by Dr. Wadsworth, of Boston, that he had seen the entire ring with the upright image in a myopic eye. Shortly after this, I myself observed the same thing. This was also in a myopic eye of $\frac{1}{5}$ in a young child. The only explanation which I could give of this was that, in an elongated eye, the image of the source of light was formed in the vitreous somewhat as it is usually with the inverted image, and, as the conditions are then nearly the same, we get the same result. I applied this principle to the phantom, and, whereas I did not get the ring while an emmetropic eye was examined, I did when I changed it by lengthening the axis into a highly myopic eye. I am inclined to think from this that we should get the effect oftener in highly myopic eyes, were it not for the fact that such eyes are usually the result of a morbid elongation of the axis in which the retina becomes stretched, as is seen by the straightened course of the vessels. This would, of course, have a tendency to equalize any want of level at the region of the macula, even if it had previously existed.

From what has been stated in the foregoing remarks, and from other considerations which need not be dwelt on further, I am still of the opinion that the halo round the macu-

la seen with the inverted image " is the product of reflection and refraction from the combination of curved surfaces which enter into the construction of this portion of the retina," and that, furthermore, the principal sources of light from which these reflections are produced are the images of the ophthalmoscope and lamp situated in the media of the eye.

The next paper was then read.

HYPERMETROPIC SQUINT AND INSUFFICIENCY OF THE INTERNAL RECTI.

By EDMUND HANSEN, M. D., Copenhagen.

1. *Concomitant Convergent Strabismus.*—A. von Graefe attempted definitely to establish that in this form of squinting there could be no question of a paralysis of the elongated muscle. His argument was very convincing, and is probably universally accepted. When, however, with reference to the much more probable supposition of spasm of the shortened muscle, he confined his remarks to a few lines in which he stated that what he had brought forward against the possibility of a paralysis of the elongated muscle could, *mutatis mutandis*, also stand for the former as well, I am disposed to think that this was somewhat wanting in clearness, because the spasm of the muscles of the eye is, on the whole, a subject which has been very little studied, and such a spasm can by no means be represented as a phenomenon directly opposed to paralysis. To me, this is so far of minor importance, as I also am not inclined to look upon spasm, in the ordinary acceptation of the word, as the cause of concomitant strabismus. Graefe considered that his argument showed that the symptoms of concomitant squint differ entirely from any anomaly of innervation. According to him, squinting is the expression for a disproportion between the mean lengths of the muscles. He allows that precisely the same phenomena would occur from abnormal attachments of the muscles; but it is clear, from what he says, that he looks upon squinting

as, in most cases, a sequence of structural changes in the muscle. He says expressly that the *altered muscular tissue answers in a different manner to the unaltered nervous impulses* (*Arch. für Ophth.*, vol. iii., p. 185). Squinting becomes thus an expression for a completely *passive* condition of the muscle.

We should suppose that Donders's doctrine, which places convergent strabismus in such extremely close relationship to anomalies of refraction, and to the relative variations in accommodation dependent thereon, must have introduced quite another way of looking upon the subject; must, in fact, have had the effect of *reversing* Graefe's proposition, so that, instead of reading thus: *unaltered innervation, other conditions of muscular tension*, it ought to be formulated as follows: *The altered conditions of muscular tension are due to altered conditions of innervation.* After Donders had established the frequent connection between hypermetropia and convergent squinting, he demonstrated why the former should give rise to the latter; but he has not, as far as I am aware, entered upon any investigations to determine the condition of the muscles—probably because he considered the relation to be sufficiently explained by the connection between accommodation and convergence. Although Donders's doctrine is all but universally accepted, there has been an evident reluctance in drawing the proper conclusions from it, probably because these necessitate—it appears to me—a modification in Graefe's conception of a structural change in the muscle. On the contrary, this idea has been, in general, held with a certain tenacity. I shall merely mention that *Giraud-Teulon* had, a good many years ago, held, as the primary cause of convergent squinting, a muscular anomaly, in consequence of which parallelism could only be maintained by a struggle between the tendencies of the muscle and the power of fusion, so that frequent diplopia resulted; hypermetropia being in a manner only secondary, and turning the balance in favor of the pathological convergence.

This opinion, which, at the time of its publication, did not by any means gain general support, has been lately taken up in a somewhat modified form by Schneller. To this I shall shortly revert.

Of the later contributions to this question must especially be mentioned one by Alfred Graefe (*Handbuch der gesammten Augenheilkunde*, Von Graefe and Saemisch) and one by Von Hasner (*Beiträge zur Physiologie und Pathologie des Auges*).

Alfred Graefe here defines his position sufficiently well in denominating concomitant squinting *das muskuläre Schielen*, and says he must designate it as *myopathic*. He further says that squinting *schlechterdings doch keine andere Auffassung zulässt*. According to him, the excess of contraction which gives rise to the abnormal position, when the squinting is *permanent*, is only passive. For Graefe, the following is the state of affairs: While, in the normal condition, *parallelism* is the state of rest, in strabismus the *squinting position* is equally that of rest. He evidently looks upon the excess of tension of the rectus internus, which gives rise to the squint, as a pure physical condition of the muscle, the length which it has in the squinting position being a consequence *of its physical properties, independent of any innervation.*

Hasner takes up a somewhat similar position. He blames Donders for having lost sight of the real nature of strabismus in his investigations into its etiology, and in his attempts at showing the important connection of anomalies of refraction to it. Hasner looks upon squinting as a disturbance in the equilibrium or position of rest of the eyes, an abnormality in the binocular primary position; only he seems to lay most stress on the *anatomical equilibrium*, while Alfred Graefe seems more inclined to admit of an *acquired* structural change.

I shall endeavor to show, in what follows, that the *myopathic* or *anatomical* foundation for squinting is due to a false conception, and that it can only, by a stretch of imagination, be made to harmonize with Donders's doctrine, and with the true condition. I consider it no vain speculation to attempt to clear up our ideas as to the nature of strabismus, as a proper conception thereof is certainly not without importance for the differential diagnosis of the different forms of squinting, as well as for the proper dosing of the desired operative effect, and the prognosis of the *definite* position subsequent to the operation. I published, a couple of years ago,

some of my opinions on this point (*Hospitals-Tidende*, 2 Rakke, Nos. 12, 13); but am induced again to broach the subject, partly because I have modified them in some points, and partly on account of the recent publications of Alfred Graefe and Hasner.

In so far as strabismus is dependent on hypermetropia, Donders's doctrine goes to show that it arises when the *normal* relation between accommodation and convergence is so accurately balanced that a certain quantity of accommodation induces the same amount of convergence, as is the case in the normal individual. The real cause of squinting is, then, the *abnormal situation* of the range of accommodation. When strabismus does *not* arise in an individual who is hypermetropic, this is due, among other things, to the range of the *relative* accommodation being sufficiently great, or, what comes to the same thing, to there being a sufficient power of liberating the convergence from its dependence upon accommodation; or it depends upon the fact that there is, on the whole, no longer any connection between accommodation and convergence. In the first case there will be under all circumstances *latent* convergent squint, in the other not even *latent* convergence is present, and there may even indeed be divergence behind the hand placed before the eye. What causes the development of a latent into a manifest squint has been sufficiently explained by Donders, consequently I need not enter upon it here.

When, therefore, we exclude from consideration the demands for binocular vision, it can with justice be said that the more *normal* a hypermetropic individual is, i. e., the more completely the relation between convergence and accommodation is preserved, the more necessary will it be for him to squint. Thus, for example, when an individual with hypermetropia $\frac{1}{8}$ looks at an object at an infinite distance, he uses $\frac{1}{8}$ of the range of his accommodation, and, to this amount, a convergence necessary for an object at 8″ distance is the normal correspondent. In order that there should be binocular vision, parallelism is demanded, but here there is an angle of convergence of $x°$. The condition becomes then as a matter of fact, that the one eye, the one used in fixation,

remains unaltered in its position, while the other, the squinting eye, is turned inward to an extent corresponding to the whole angle of $x°$. If, now, there be any meaning in the connection between accommodation and convergence, so that increased convergence induces sufficient accommodation to enable the eye which has preserved its position to see *distinctly*, then the fixing eye, notwithstanding its unaltered position, must receive exactly the same amount of innervation to convergence as the squinting one.

Here we must follow *Hering's* explanation of what happens when the object fixed is approached to the eyes, without the visual axis of the one eye being changed in position. The continuance of the one eye in its position must be looked upon as a result of a double innervation, firstly, an innervation to convergence which would cause an adduction to the extent of $\frac{1}{2}$ the angle $x°$; and, secondly, an innervation to abduction which would bring it back through the same angle to its point of departure. This innervation to abduction would produce, owing to associated movement, a further adduction equal to $\frac{1}{2}$ the angle $x°$ in the other eye, already convergent to the extent of $\frac{1}{2}$ the angle x, producing, therefore, together an adduction equal to the whole angle x. The same holds good for squinting, where, however, the same process takes place, not from the approaching of the object, but because the accommodation demands it. It must, therefore, be considered as established, that in strabismus *the innervation to convergence is equally strong in both eyes*, in the squinting as well as in the fixing eye, while the adduction of the former is dependent only partly on an innervation to convergence, and partly, on the other hand, to an associated innervation inducing lateral movement.

This supposition of equal shortening of the interni of both eyes, which is accepted among others by Arlt, is of great importance, because even those who look upon the shortening of the muscles as *passive*, as a structural change, must at least look for a part of this shortening as well in the *non-squinting* as in the squinting eye, if they wish to place strabismus in any relation to hypermetropia, if even they should not ascribe any further influence to this anomaly of refraction than

that of first originating the squint. Alfred Graefe certainly says: "Die vorstehende Betrachtungsweise (viz., the myopathic) wird einer Modification nicht bedürfen, *wenn* wir mit Arlt annehmen, dass bei Strab. converg. eigentlich beide musc. rect. int. abnorm verkürzt sind." His explanation of the transportation of the whole of the convergence to the one eye is the same as that given above. It is, however, clear that he cannot in that case hold to his idea of a passive shortening in the muscle of the squinting eye to a greater extent than for half the angle, while the other half must necessarily be an *active innervated* adduction. Further, several points in his paper show that he does not accept the supposition of an equal shortening of both interni.

With regard to the movements of the eye in squinting, A. von Graefe called attention to the fact that the movements of the two eyes were perfectly *associated;* and, further, that the displacement of the whole arc of movement, although never wholly wanting, was at any rate always much less than the angle of the squint. Alfred Graefe even declares (and this is undoubtedly the case in the majority of squints of not too great an angle) that such a displacement of the arc of movement in many cases does not take place *at all*, or is at least only very slight. How this can be made to agree with a passive shortening of and structural change in the muscle, I cannot understand. A. von Graefe says that, "as far as the squinting angle is concerned, the effect is the same, whether you imagine the muscle to be passively shortened, or its insertion changed while it retains its length." Let us figure to ourselves, then, this last condition, brought about in such a way that the muscles are detached, while at the same time retaining their length, and the eyeball, rotated inward until the inner border of the cornea touches the rectus internus, the position of the externus, relatively to the eyeball, being changed to a corresponding extent outwardly. Allow the muscles to become attached in this new position, then the result would, in the first place, be a squinting angle corresponding in size to the extent to which the internus had been moved forward. The movements of the *eyeball* would not have undergone any change, but the limit for the outward and inward turning of

the *cornea* would be changed to precisely the extent of the altered position, that is to say, the angle of the squint. Although the supposed passive change in the internus muscle is certainly not connected with any change in the insertion of the externus, still something similar to the effect of the above imagined case must take place, and it is therefore scarcely comprehensible that no greater influence on the limits of the movements can be traced than is generally the case.

Certainly A. von Graefe has said that such a defect in the outward movement, as must be occasioned by the passive shortening, might be compensated for by an increase in the innervation, as the muscles possess more power than is merely sufficient to reach the usual limit of movement; but he dismisses such an explanation by showing how it would influence the normal relations of association in squinting. A greatly-increased secondary squinting angle in the other eye would immediately betray the increase of innervation which was to cover the loss of movement in the first.

It is just the retaining of these normal relations of association which causes the concomitant squint to differ so widely from the paralytic, and it is owing to the recognition hereof, that I cannot agree with Schneller in his conception of its etiology. Schneller has, as well as others before him, made the field of possible movement (the Blickfeld) the object of his investigations, and has in a praiseworthy manner also extended his investigation of this field in abnormal conditions, both in manifest and latent squint.

Although he does not completely deny a contraction and structural change in the muscle causing the squint, still he attributes to it a very secondary importance. From his examination of the Blickfeld he has come to the conclusion that in squinting there is a disproportion in the relationship between the abduction and adduction of the squinting eye, not in such a way as to *increase* the movement in the direction of the squint, but, on the other hand, to *diminish* it in the opposite direction. In convergent squint there is, therefore, a *weakness* of the rectus externus, in divergent squint of the rectus internus.

He expressly uses the word *weakness*, and thereby, it ap-

pears to me, at once condemns his own doctrine. As will be seen, this is just the old idea of Giraud-Teulon revived. In convergent squint the process is supposed to be the following: The recti externi are too weak compared to the interni which remain normal; the divergence of the visual axes necessary for parallelism becomes thereby impossible, or so difficult to maintain that, on the addition of hypermetropia, differences of refraction or vision in the two eyes, convergence gains the ascendency. While I admit that Schneller's examination of the Blickfeld is a somewhat more reliable means of determining the limits of motion than that which merely takes account of the amount of adduction and abduction of the eye, in relation to the caruncle or canthus externus, as the conformation of the eyelid is subject to numerous variations, it must on the other hand be held that the determination of the Blickfeld is for many reasons not a correct expression for the outer limits. But, even if this were the case, it is thereby by no means shown that, an absolute loss of motion in any one direction should necessarily produce squinting. I shall later revert to the reason why this does not prove anything. Here I have merely to show that, if it really were a weakness of the externi which occasioned squinting, the principal difference between the concomitant and paralytic squints would fall to the ground. How a weakness of the externi could be distinguished from paralysis or paresis is to me a complete riddle, and the doctrine of association would thus be entirely done away with for concomitant squint, as it is for paralytic. Not even the circumstance that both externi were equally weakened, which Schneller by no means admits to be the case in squinting, would make any important difference, no more indeed than a recent squint due to an equal bilateral abducens paresis would in the least degree resemble a concomitant strabismus convergens. I imagine that this principal objection to Schneller's supposition releases me from criticising more exhaustively his observations. It would not be difficult to show that even some of the examples brought forward by him to render the different types of squinting probable, by no means explain what he wishes they should.

The conditions in squinting are, in my opinion, fully ex-

plained when it is considered to consist of *an active shortening of the muscle, equal in both eyes, brought about by increased innervation to convergence.*

Let us imagine an individual with normal vision looking at an object at the distance of 8″. When the object *at this distance* is constantly moved from right to left and from left to right, and both eyes follow this movement, then it will be seen that the same convergence is preserved without the laws of association being in the least degree violated, although the tension on account of the continual convergence is of course quite different from what it is when the same movements take place during parallelism. In this instance it is a shortening due to an active increased innervation to convergence, which keeps up the convergence with perfect preservation of association for movements in all directions. The condition in squinting is quite the same, with this difference only, that while normal convergence fulfills *the demands of binocular vision*, the convergence in squinting satisfies *the want of accommodation*, and puts aside the demands of binocular vision.

But the *aim and object* of the convergence is without influence on the conditions of motion. The question would be very simple, the explanation of squinting and the relations of the movements easily comprehensible, if we always had to do with the fixation of an object, and the accommodation and excessive convergence dependent thereon. But, when the squint is *permanent*, there is also pathological convergence, in the state of vacant gaze when no definite object is fixed, although there is no demand for accommodation or convergence. Here the condition is as follows: Every squint due to hypermetropia, which has become *permanent*, exhibits a smaller squinting angle in the state of absolute rest than when fixation has supervened. On fixation an increase of the squinting angle takes place. The difference between the permanent and increased angle varies greatly in different cases: sometimes it is very considerable, sometimes again very slight. It is natural to suppose that the permanent squinting angle *plus* the increased squinting angle is an expression for the abnormal convergence induced by the exertion of accommodation. But the difficulty here is, why there should be more or less conver-

gence remaining after the cessation of all accommodation, and it is precisely this which gives rise to the assumption of a structural change in the muscle or other abnormalities (in the congenital position of equilibrium). Generally far too little stress is laid on this variation in the size of the squinting angle, although Donders gave sufficient weight to it. We generally determine the degree of squinting, by letting the patient fix an object at the distance of several feet (Graefe's medium distance) and then notice the deviation, but the permanent squinting angle (an expression for the supposed structural change) forms consequently only a greater or smaller part thereof. This is naturally of great importance, as it is only the degree of the permanent squinting angle which should guide us in dosing the effect of the proposed operation. It must be admitted, however, that the degree of the permanent angle is difficult to determine in this way, as every attempt at accurate measurement liberates the additional squint by introducing fixation.

We generally understand, by the denomination "absolute position of equilibrium," that position of the eye which is the result solely of its anatomical relations and the *elastic* tension of the antagonistic muscles, as we imagine both the rectus externus and internus to be perfectly relaxed. That such a position is conceivable is undoubted, but it scarcely ever occurs except, perhaps, in the most profound sleep, after death, etc. A. von Graefe has long since expressed the opinion that the muscles must be considered as *permanently innervated*, even in the vacant gaze. The position assumed on exclusion of the one eye is to be looked upon as an expression, not for an absolute, but merely a relative rest. The innervation which, at such moments, governs the muscles is *unconscious innervation*, not under control of the will, or subject to its dictates. Without the assumption of such a permanent innervation it would be difficult, among other things, to understand that it is the *rule*, rather than the exception, in abducens paresis, that the convergent squint thereby occasioned extends, from the moment of its origin, far into the other side of the Blickfeld, without our being in the least justified, therefore, in assuming a contraction or spasm of the antagonistic muscle.

In consideration of the very varying position of the orbits, of the aponeurotic surroundings of the eye, and of the not inconsiderable varieties in the points of insertion of the muscles, we could scarcely imagine that what we generally call the position of equilibrium corresponds, in the majority of cases, to parallelism of the visual axes. It is much more natural to suppose that this position is a result of the functional demands.

Parallelism, the position of the eyes for looking at a distance, is, so to speak, the real zero-point of convergence, but whether or not it is the zero-point of *convergent innervation* is certainly dependent on the given anatomical position of equilibrium, as parallelism in a given anatomical divergent position cannot involve the same innervation as in a given anatomical convergent or parallel position. As it must be considered more probable that the given anatomical position varies under normal conditions, within certain limits, not so inconsiderable, and we generally find parallelism behind the hand placed before the eye, this shows that the innervation causing this position is, from habit, independent of the will of the individual. How great an influence the accustomed and frequently-demanded positions exercise on the property or power of arriving at them, is well known, and, on the other hand, how difficult the positions which do not serve a purpose are executed, is seen, among other things, from our not being able to place our eyes in a divergent position, which even approaches the possible abduction of either. In the relations of the muscles there is no hinderance at all to this; it is simply owing to the fact that a negative innervation to convergence, if I may so call it, does not exist, because we have never any use for it. When, therefore, on the other hand, in hypermetropia a more or less *constant* pathological convergence takes place, also in order to serve a purpose, namely, to liberate the necessary amount of accommodation, then there arises, from habit, a permanently *increased* innervation to convergence, which withdraws from the voluntary power of the individual that portion of the whole range of innervation which is nearest its absolute point of rest. But, if this be correct, it is the *displacement of the conscious point of rest* of the *innervation* which causes the permanent shortening of the muscle. It

might be called a spasm of the convergence, wherein the abnormal change is not to be sought in the muscles, nor in the conducting apparatus, but, *in the centre for convergence.* Such a spasmodic convergence is sometimes met with in certain cerebral affections, where the symptoms are such as do not correspond either with a paralysis or spasm of any particular muscle, but can only be explained by the assumption of an excitation of the centre for convergence, which deprives the individual of the free use of that part of the innervation to convergence lying nearest its zero-point.

A. von Graefe has also assumed such a "latency" of the great portion of convergence, as he held that complete parallelism of the visual axes for distant fixation, found by the use of prisms breaking up the light vertically, could not be looked upon as if it were the position of absolute equilibrium in all cases (in cases of myopia from insufficiency), but was only an expression for the fact that the really existing absolute divergent position of equilibrium continued latent, even after covering one eye, or dissociating binocular vision by means of a prism.

It may, therefore, be considered settled, that the position of equilibrium ascertained, in the usual manner, does not coincide with the absolute (that which is demanded from the anatomical relations).

We might, therefore, express ourselves thus: Parallelism is the position of equilibrium which unconscious innervation gives rises to under ordinary circumstances, while, in squinting, the position of equilibrium assumed on unconscious innervation is the permanent squinting position. But this idea differs greatly from Alfred Graefe's, who evidently sees in the squinting position also a changed position of equilibrium, as, according to him, the cause lies in the muscle which has undergone a change, whereas, in my opinion, it lies in the centre for convergence. A more thorough investigation shows that we not unfrequently observe successive changes in the so-called position of equilibrium, occurring in the course of time. I can thus, on the one hand, refer to convergent squint slowly and gradually developing itself in myopia; on the other hand, to the equally gradual cessation of squinting, with age, in

many hypermetropic individuals. It is quite evident that this undoubtedly contradicts Von Hasner's supposition of an abnormality of absolute equilibrium, owing to *anatomical* conditions, but it is also not favorable to the assumption of an acquired structural change, of successive changes subject to the state of nourishment of the muscle, especially when it must further be maintained that the relation of the muscle, in all other respects, must be considered as normal. We should do Alfred Graefe an injustice, were we not to acknowledge that he recognized a relationship between hypermetropia and pathological convergence, but he undoubtedly draws a sharp distinction between "accommodative convergence," by which designation he denominates the hypermetropic and always periodic squint, and the permanent squint due to an organic shortening of the muscle. Further, it is very striking that Alfred Graefe has not seen how untenable this supposition was, as it was he who first drew attention to the phenomenon, which had been, however, observed and rightly conceived by most, before his publication, that the law of the identity of the primary and secondary squinting angle is often overthrown in cases of unequal refraction of both eyes. Certainly he thinks that this generally takes place in cases of periodic and latent squint, but he acknowledges the undoubted fact that it can also be found in permanent squints. It is not easy to understand how this can agree with the supposition of an organic shortening of the muscle.

The result of the preceding considerations is, therefore, the following: Every hypermetropic squint depends upon the relation between accommodation and convergence. Convergence is partly an immediate expression for the accommodation used in the moment of fixation, partly an expression for the *unconscious* innervation to convergence arising from accommodation, and lasting during its state of rest. There are two positions always exhibited in squinting, which, as above mentioned, Donders has specially drawn attention to, and which are recognized by most others, although sufficient stress is not laid upon it, viz.: 1. The permanent squinting angle; 2. The additional squinting angle arising during accurate fixation. The difference in degree between these two positions is subject to

great variation. It may be very little, or so great that the permanent squint is = 0, or even, as may be seen in not a few cases, goes over to divergence during the vacant gaze. The *absolute* position of equilibrium arising from the relations may influence this in such a way that parallelism, in moments of distraction (periodic squint), may often be just as much an expression for increased innervation to convergence as a decided permanent convergence. The given *absolute anatomical* equilibrium is, however, never known for certainty, as it generally does not coincide with the so-called position of equilibrium discovered in the usual way (behind the hand, with prisms breaking up the light vertically). Least of all can we recognize it in squinting, where every attempt at fixation, by which, however, we generally test the position of equilibrium, liberates the convergent squint. By assuming a given anatomical *divergent* position of equilibrium, we could also understand why squinting often remains periodic during a whole lifetime; we cannot, as I have elsewhere shown (*Hospitals-Tidende*), ascribe it to a resolute adhesion to binocular vision, which, in most cases of periodic squinting, does not exist at any moment during the act of vision.

Probably my assumption of an abnormality of innervation, as opposed to the myopathic supposition, will be met with the objection that it only rests on an undemonstrated hypothesis. But is it otherwise with the myopathic supposition? Has the presumed anatomical change in the structure of the muscle, or anomalies of insertion, etc., in fact anything to support such a supposition, ever been demonstrated? The question comes to be, then, which hypothesis coincides best with the facts observed. Considered in this light, the following facts cannot be explained by the myopathic supposition: 1. Structural change in a squint arising suddenly, so quickly becoming permanent, and the absence of such in squints remaining periodic through life. 2. The not infrequent exception to the law of the identity of the primary and secondary squinting angles. 3. The cessation of squinting in many cases as age advances. 4. The disagreement between the size of the angle of the squint and the extent of the displacement of the arc of movement. 5. The undoubted property existing in squinting, of

preventing or postponing the occurrence of accommodative asthenopia.

According to the supposition of a myopathy, the connection with hypermetropia must be looked upon as if this state of refraction were only of importance in giving rise to squint, but had no further relation to it, because, if strabismus be an altered position of equilibrium due to a *passive* change in the muscle, it can have no influence on accommodation, as only an *innervation* to shortening can induce accommodation.

I have already brought forward my reasons for considering Schneller unjustified in arriving at the conclusion he does, as to the etiology of strabismus. It is clear that even the limitation of the outer limit of the Blickfeld, if indeed it were always as definite as Schneller supposes it to be, cannot explain the origin of squinting. We could thus easily imagine that a mechanical obstacle, a tumor, etc., diminished the movement to the extent of 1–2‴. In so far as this object was not present, except in the outermost part of the Blickfeld, it is clear that it could have no influence on the position of equilibrium for fixation at an infinite distance, because, as the innervation is here the same, and no mechanical action has any effect *here*, such an influence could not be understood. On the other hand, we know, from the study of the pareses, that even the slightest defect of outward movement always exhibits itself in the position of equilibrium for the fixation of an object at a distance, and lying straight out, sometimes accompanied by diplopia, at other times not, according to the power of fusion.

Schneller's so-called weakness of the externi is necessarily completely identical with paresis, as it, like paresis, appears over the whole of the Blickfeld, even although its cause and site may be different. Thus, also, we overthrow the laws of association in performing a tenotomy of the rectus externus, by which limitation of the Blickfeld is produced, and arrive at symptoms perfectly similar to those of paresis.

I cannot deny that I was for a long time inclined to place the unconscious continuous innervation to convergence, which, in my opinion, is the basis of permanent squinting, in very close relation with latent hypermetropia, and this owing to

the apparent analogous nature of these conditions, as well as with regard to the influence which the one could exercise over the other. By the habit of accommodation, its zero-point and that part lying nearest to it are abstracted from the use of the individual. Schweigger has already indicated the analogy between the two conditions, and that they bear a great resemblance cannot be doubted. On the other hand, the *permanent squint* can scarcely, with justice, be considered as immediately and constantly dependent on the latent accommodation. In the first place, there is no constant relation between the size of the permanent squinting angle and the degree of latent hypermetropia; secondly, we see the latent accommodation completely disappear in the course of time, without the simultaneous disappearance of the convergence. The most weighty objection, however, is that brought forward by Mauthner, and lately by Schnabel, viz., that we must certainly look upon the latency of accommodation in this way, that a portion of the range of accommodation is removed from the free use of the individual, so that, at every attempt to see, a certain quantity of accommodation is made use of, and that convex glasses, which *do not attain to*, not to mention exceed, the degree of hypermetropia, render vision indistinct. But this unintentional tension of the ciliary muscle disappears in the vacant gaze, and the total degree of hypermetropia can, therefore, be recognized with the ophthalmoscope. There are, therefore, in such a case, moments of complete relaxation, although they are not subject to the will of the individual, while we do not see anything corresponding to this in permanent squinting, although it is difficult to judge of the condition, for instance, during sleep, where, possibly, a similar cessation of the squint takes place. With regard to the observation that the total hypermetropia can always be diagnosed with the ophthalmoscope, it is probably, on the whole, correct; still I cannot omit making a few objections to some of Schnabel's assertions. He explains the latency of hypermetropia, as it shows itself in the subjective testing of vision, by saying that it is simply owing to the usual connection between convergence and accommodation, but this is a very unsatisfactory explanation, at least as he does not follow it up with anything

more definite. He who considers parallelism as the zero-point of innervation to convergence has no reason to suppose that such parallelism liberates any accommodation, and, on the other hand, it is not easy to see why parallelism by fixation of an object (test of vision) should liberate another condition of accommodation, any more than the same parallelism during the examination with the ophthalmoscope, and yet Schnabel considers that accommodation is perfectly at rest in this case. It is a much more probable supposition that it is the desire to see distinctly that induces the accommodation while testing the vision, *although* it is not supported by convergence, as in the normal individual, while accommodation is put perfectly at rest when, as during ophthalmoscopic examination, there exists no desire for vision.

This explanation agrees with the observation that, *during* the ophthalmoscopic examination of an hypermetropic individual, you very frequently notice not unimportant variations in the degree of the hypermetropia, just because the examination, which, of course, cannot be conducted in absolute darkness, does not, therefore, completely exclude a desire to see. This is one of the reasons why, on the whole, the ophthalmoscopic determination of refraction can never have the precision which most ascribe to it. The other reasons which can be brought forward against the attainment of such precision are too lightly passed over by Schnabel.

I consider it a very important objection that we have not got in the papilla, or in the macula lutea, a sufficiently well-defined object of vision, which enables us to choose the glass giving the greatest distinctness with the same precision as in using the types of Snellen. Even with these types—that is to say, with subjective tests—the choice of the *best* glass is not easy even for an intelligent patient (to this reason may be ascribed the frequent variations, within not very narrow limits, of the definite refraction for different days); and where, moreover, a definite object of vision is wanting, the determination of what glass makes the image most distinct is very difficult. The determination of the refraction of the papilla is, of course, the easiest, but it often differs "*very considerably* from that of the macula lutea." In myopia, especially, it gives

constantly a much smaller refraction, while in hypermetropia it sometimes gives a higher (minor degree of hypermetropia).

Finally, it must not be lost sight of that the very slanting position given to the glass behind the hole of the mirrror, owing to the way in which it is held, changes its refraction in no unimportant degree, so as to produce the effect of a cylindrical glass. This objection, to which Reuss has drawn attention, I have already long ago obviated by placing before the patient's eyes glasses in a position parallel to them. The difference in the results obtained by this method, and the ordinary examination with Loring's or any similarly-constructed mirror, is very considerable. Although I have not so much faith in the precise ophthalmoscopical determination of refraction as others, still I recognize the fact that it is possible thus to unmask a great part, perhaps the greatest part, of the latent hypermetropia. But, because accommodation, even in a hypermetropic individual, has its moments of complete relaxation, it does not necessarily follow that the same obtains for convergence.

It would, as a matter of course, be very one-sided if we were to imagine every squint to be an anomaly of innervation dependent on hypermetropia and the habit of convergence. That there are cases depending on a primarily-disturbed physical state of equilibrium, according to Hasner's idea, is scarcely doubtful. Whether this disturbance is due to abnormal muscular insertion, physically abnormal length of the muscle, possible structural anomalies, or, what is also conceivable, abnormalities of the adnexa of the eye (aponeurotic elongation from the sheaths of the tendons to the orbit), pathological anatomy gives us no clew.

To enter any further upon the different forms of squint (alternating squint without hypermetropia, congenital squint, etc.), for which such an explanation lies near, would carry me beyond the bounds of that which it was my intention to elucidate.

II. *Insufficiency of the Interni.*—Even should the supposition of an anomaly of innervation, as the foundation for the frequent form of squinting, be looked upon as only an hypoth-

esis which can with difficulty be demonstrated, it is, on the other hand, much more undoubted that latent divergence, so called insufficiency of the interni, is not dependent on a muscular anomaly, but upon different kinds of anomalies of innervation. However evident this becomes on closer consideration of all the attendant circumstances, yet this conception of the affection has received so small an amount of general acceptation that it would, on the contrary, not be difficult to show that even the latest authors on this subject have not been able to free themselves of the idea of a muscular weakness.

My friend and clinical assistant, Dr. Krenchel, has, in a paper "Ueber die krankhaftverringerte Fusionsbreite" (*Archiv für Ophth.*), treated this subject with so much precision that it might be considered superfluous to return to it. As the object of the above-mentioned paper was to attract attention to the influence of the morbidly-diminished power of fusion in causing the occurrence of symptoms of insufficiency, it is possible that a certain concise manner of expressing himself has been the reason why his otherwise very complete paper has not received the attention it undoubtedly deserves.

It must be considered certain that there are three principal factors regulating convergence in the act of vision. 1. The consciousness, from experience, or otherwise acquired, of the approximate distance of the object. 2. Accommodation, which, from its more or less intimate connection with convergence, gives rise to it. 3. Fusion, or, if preferred, the tendency to bring the most sensitive part of the retina, the macula lutea of both eyes, to bear upon the same object.

That the first condition is able, quite independently of the other two, to bring about convergence, can often practically be seen in patients with a high degree of myopia, and in whom binocular vision has ceased. An individual, for instance, with myopia $\frac{1}{4}$—$\frac{1}{3}$ has, we shall say, a divergent squint of 3″ for infinite fixation, and at no distance, under any circumstances, binocular vision. On approaching an object to 10–8–6″ from the eye, it will often be seen that the divergent eye does not remain stationary, but makes a greater or less convergent movement. Divergence, in relation to the de-

sired convergence, is perhaps now as great as ever, but a movement of convergence has still taken place in both eyes. Fusion is, of course, without influence here, as there is no binocular vision, and accommodation also, as the object lies still beyond the *punctum remotum*. The normal influence of fusion and accommodation may here be neglected, as our object is merely to consider the anomalies in their several relationships; so much only is undoubted that that which gives rise to convergence is an impulse proceeding from the nerve-centres. Although, from the investigations of Adamuik and others, it must be looked upon as certain that the centre for the movements of convergence is situated in the corpora quadrigemina, still it is at the same time certain that defective convergence may be occasioned by morbid processes which have their site in other centres as well.

Krenchel has shown with a clearness amounting to conviction that defective convergence must not be looked for in the muscles or in the conducting apparatus, as that would occasion the same symptoms as a paresis, and as the greatest convergence demanded falls very far short of the total degree of adduction which each muscle is able to bring about by associated lateral movements.

A purely latent divergence is dependent on some disturbance in the central apparatus, when not due to an abnormal position of rest. On noticing the different forms of so-called insufficiency, it will be evident what part the various factors producing convergence play in the different anomalies which may arise.

1. Relative insufficiency is without comparison the most frequent form, although it was a long time after Graefe's publication before the proper conditions were recognized, yet the true conception must now have gained ground. It is only found in myopic individuals. When an individual with myopia $\frac{1}{7}$, in whom the normal relation between convergence and accommodation is preserved, looks at an object at the distance of $7''$, the convergence demanded is already considerable, while the accommodation demanded $= 0$. If fusion be good, he places his eyes properly, notwithstanding faulty support from the side of the accommodation.

If fusion cease (in exclusion of the one eye by holding an object before it), convergence also = 0, or is very much diminished (the consciousness of the proximity of the object may sometimes induce more or less convergence). The eye, therefore, moves outward. It is thus a perfectly normal condition, and nothing here points to a weakening of the muscle. Eight or nine years ago I introduced as an object for fixation a short word, printed in the characters Nos. 1 and 2 Jaeger, instead of the dot and line of general use, as only in this way can we be sure that the patient is properly accommodated. Mauthner now uses the same method, but scarcely lays sufficient stress on it. Schweigger was really the first to dwell upon the relative character of insufficiency in myopia, although I had already several years before drawn attention to this in my clinique. To insure an accurate accommodation is, of course, also of great importance for the test of adduction necessary for the proper conception of the symptom of insufficiency, because in adduction the important point to ascertain is not its absolute degree, the only thing we can learn from testing with a dot, but its degree relatively to accommodation. A good power of fusion will naturally overcome, by adduction, prisms which are much stronger than those which could be overcome by a simultaneous preservation of correct accommodation.

What consequences, with regard to treatment and otherwise, the conception of myopic insufficiency, as completely relative, must carry along with it, have all been brought forward by Schweigger and Mauthner, although, perhaps, as far as operative treatment is concerned, not sufficiently estimated.

2. Quite different from the preceding is the latent divergence which occurs in emmetropia, or in hypermetropia, and minor degrees of myopia. In such an individual, who in the testing of equilibrium at a distance preserves parallelism, you sometimes see (although this in comparison to the preceding category of cases is much rarer) that, at the distance necessary for reading, the excluded eye diverges more or less outward. Here, then, the test with a finely-printed word is completely indispensable, and that with a dot perfectly useless; and, besides, it is necessary constantly to see if the pa-

tient be properly accommodated. If the divergence be but small (5°–6°, or even somewhat greater), no special stress need be laid on this, as the normal connection between accommodation and convergence, although intimate, is still not so accurate that such a small amount of divergence arises almost *as a rule* on the cessation of fusion. But, if a considerable outward movement be found (15°–20°), or if even the eye be placed completely parallel to the other, this is an expression for the *cessation* of the normal connection between accommodation and convergence. Fusion has certainly the power of bringing about the proper position, but the support of the convergence on the part of the accommodation is wanting. It is a matter of course that such a liberation is a central act, not an expression for a muscular weakness, but it can also be shown in the usual manner (by prisms, etc.). Cases of this kind, which arise after some debilitating illness, sometimes also without any demonstrable cause, give rise much oftener than the preceding form to muscular asthenopia. Treatment with prisms is generally of use here.

3. Divergence depending on the want of fusion. This, which is more exhaustively treated in Krenchel's paper, is certainly also much less frequent than the first form, but is not by any means absolutely rare. In its uncomplicated form it generally betrays itself by double vision, in reading (or, at any rate, exceedingly defective endurance alternating with diplopia). There is equilibrium for an infinite distance, but adduction as well as abduction only forms a greater or less *part* of the normal amount. In testing for near objects there is often only a slight divergence, which nearly coincides with that found in the normal individual as an expression for the not absolutely accurate connection between accommodation and convergence (5°–10°, therefore). That the divergence is not greater here is due to the fact that the connection between accommodation and convergence is normally preserved. Whether, therefore, at the reading distance double vision or complaints of asthenopia arise or not is dependent upon whether the slight power of fusion found on testing for a distance is able to cover this divergence. If the adduction were only 6° for a distance, then there would be a manifest

divergence at the reading distance, or even if it were somewhat greater, it would scarcely be able *continually* to prevent diplopia. What is characteristic about this form is, therefore, the diplopia occurring already at the reading distance at once manifestly, or quickly becoming so, *notwithstanding the small amount of divergence.* Here prisms also do much good when the defect in fusion is not too pronounced.

No other forms of insufficiency exist; but, as a matter of course, these already referred to are found combined in various degrees, giving to the affection different characters. Moreover, the position of equilibrium at a distance has also a great influence on the result found on examination for near vision. It will be apparent that a small amount of divergence for vision at an infinite distance will be of great importance for the form depending upon defective fusion. If, therefore, a divergence in the position of equilibrium for a distance to the extent of 5°–6° be found in any case, it will, on being added to the latent divergence, which also exists in the normal individual, and which amounts to 6°–8°, give rise to a divergence of 11°–14°, which the diminished power of adduction must compensate for, and this *continually* if diplopia or defective endurance in reading is to be avoided.

The report of the committee of two, appointed to consider the communication presented to the Congress by Dr. E. Seguin, was then read by the Secretary, in which it was recommended that a delegate be appointed from this Congress to the International Medical Congress, to be held in Geneva, in 1877, to represent the views of the Ophthalmological Congress, upon the subject contained in the communication of Dr. Seguin.

Dr. Noyes moved that the President have power to appoint the proposed delegate. Seconded and carried.

The President: We will defer the appointment for the present.

The Congress then adjourned till September 14th, at 10.30 A. M.

Thursday, September 14th, Morning Session.

The Congress was called to order by the President at 10.30 A. M., and the minutes of the previous session read and adopted.

The President then announced the first paper.

AN OPERATION FOR CICATRICIAL ENTROPIUM AND TRICHIASIS OF THE UPPER EYELID FOLLOWING TRACHOMA, BASED UPON VON AMMON'S TARSOTOMIA HORIZONTALIS.

By JOHN GREEN, M. D., of St. Louis.

In entropium of the upper eyelid, following trachoma, and resulting from cicatricial contraction of the palpebral conjunctiva and the posterior layers of the tarsus, the important changes, from a surgical point of view, are those connected with the rounding off and disappearance of the inner or posterior lip of the lid-margin, and the acquired false position of the cilia and of the openings of the Meibomian glands. These glands are, moreover, generally atrophied and obliterated in a considerable part of their extent, and the tarsus itself is often conspicuously incurved and sometimes much thickened.

In planning an operation for this acquired deformity, it is obviously a desideratum to restore, as far as may be, the posterior lip of the lid-margin, so as to bring the openings of the Meibomian glands into their normal position at the same time that the false direction of the cilia is corrected. This can be accomplished, however, only by an operation in which the thickened or contracted tarsus is deeply incised above the row of openings of the Meibomian glands, either from its conjunctival surface, or, with the excision of a wedge-shaped strip, from the front as practised in the grooving operations of Snellen and Streatfeild.

The operation described by Von Ammon, under the name *tarsotomia horizontalis*,[1] is performed as follows: "A double-edged cataract-knife is thrust through the eyelid, from within outward, by the side of the canaliculus, and at a distance of three lines from the free margin of the lid. This incision is continued, at the same distance from the margin of the lid, to within half a line of the outer canthus. A strip of skin is next excised, and the cutaneous wound is closed by sutures. New tissue is formed in the tarsal wound."

"This method has been somewhat modified by Roser.[2] In entropium of the upper eyelid the whole lid, including the tarsus, is cut through in a line parallel to and about a line and a half distant from its ciliary border. A narrow strip of skin is next excised along the upper lip of the wound, which is then closed by sutures. The suture-needles should be entered somewhat deeply, and preferably in the line of the cilia, in order that the bridge of skin may be the better turned upward. . . . The incision gapes only to a moderate extent upon the conjunctival surface, and soon heals."

Jäsche's operation, which is said to have been designed for cases of partial trichiasis only, is thus described:[3]

"From a quarter of a line to one line above the tarsal margin, and parallel with it, a puncture is made in the tarsus from its conjunctival surface just in the part corresponding to the deviating cilia; and the wound is then extended at both ends to a length somewhat exceeding that of the part of the tarsal margin in which the faulty cilia are implanted. A fold of skin, five or six lines in width and a line and a half or two lines distant from the free margin of the lid, is next excised. Then turning the flat side of the knife next the bulb, the point is pushed through from one end of the conjunctival incision to the corresponding extremity of the cutaneous wound, and the lid margin is cut away from the rest of the tarsus so

[1] *Zeitschrift*, Bd. III., S. 247, 1833. (Quoted from Ruete, *Lehrbuch der Ophthalmologie*, 2te Auflage, II., S. 205, 1854.)

[2] *Archiv für physiologische Heilkunde*, III., 1853. (Quoted from Ruete, *op. cit.*, II., S. 205.)

[3] *Medicinische Zeitung Russlands;* 1844, No. 9. (Quoted from Arlt, in Graefe und Saemisch, *Handbuch der Augenheilkunde*, IV., I., S. 450.)

that it remains attached at its two extremities only. By means of sutures, drawing together the lips of the wound in the skin, the cut surface of the marginal segment of the tarsus is drawn upward upon the front of the tarsal cartilage, where it becomes attached."

About four years ago I made several trials of an operation in which an incision was made, substantially as described by Jäsche and Roser, through the whole thickness of the eyelid and about a line or a line and a quarter from its free border, the design being to transplant and turn forward the entire ciliary border of the lid, instead of the cutaneous and muscular layers only, as practised by Arlt, and, after him, with more or less of variation, by Von Graefe and many others. A narrow strip of skin, not exceeding a line or a line and a half in width, was next removed from the upper lip of the first incision, and three or more sutures inserted in the manner indicated in the passage just cited from Roser. The result in several cases was all that could be wished; the preservation of the cilia was perfect, and, what could hardly have been anticipated, the irregularly deviating cilia seemed after a few days to fall into line with the others, and all assumed a normal direction. The whole margin of the lid was also restored to its original width, the posterior lip being reëstablished with the openings of the Meibomian glands in normal position. In other cases, however, the result of the operation was much less satisfactory, the marginal bridge of tissue losing its vitality in part, and either sloughing in its central portion, or undergoing a process of atrophic shrinking, leading to the permanent loss of the eyelashes.

To avoid this source of danger, I was led to modify the operation, viz.: by cutting through the conjunctiva and tarsus only, in the first stage of the operation, and excising a narrow strip of skin only, in the second stage; thus preserving intact the muscular layer of the lid, and so insuring, through its blood-vessels, the nutrition of the marginal bridge.[1]

[1] Arlt modified his original operation in the same manner, and for the same reason, viz.: to insure the preservation of the vitality of the bridge of tissue bearing the cilia. (See Graefe und Saemisch, *Handbuch der Augenheilkunde*, III., I., S. 449.)

Operating in this way I have had no sign of trouble from sloughing or atrophic shrinking, and have had reason to be abundantly satisfied, both with the preservation and luxuriant growth of the cilia and with the permanent restoration of the lid-margin to its normal width and contour.

The operation may be performed with Beer's or Von Graefe's knife, everting the upper lid and holding it in that position if necessary by the tips of two fingers covered by a bit of dry linen. The point of the knife is pushed through the tarsus near its outer end, a line or a little more from the row of cilia, and is carried along between tarsus and muscle, cutting from within outward as in cutting the leaves of a book. Having in this way made an incision a few lines in length, the knife may be exchanged for a pair of strong scissors, entering the point of one blade in the incision, pushing it along between tarsus and muscle, and cutting by successive strokes through the tarsus as far as its nasal extremity. The incision is next extended at the temporal end, also, so as to cut through the tarsus in its entire length. If the tarsus is very much thickened, a wedge-shaped strip should be pared off from the upper side of the incision, but ordinarily this is not necessary. The excision of a narrow strip of skin, a line or a little more in width, and rather less than a line from the row of cilia, is conveniently accomplished, either by means of Von Graefe's cataract-knife, or by sharp-pointed scissors. From three to five sutures are ordinarily required, and they may be so inserted as to regulate the degree of eversion of the lid-margin; the maximum of effect is obtained by entering the needle in the row of eyelashes, carrying it upward just beneath the skin until its point appears in the wound, then plunging it somewhat deeply through and behind the muscular layer, and bringing it out through the skin of the eyelid two or three lines above; on tying the suture, not too tightly, the loosened margin of the lid, bearing the cilia, is tilted forward, and drawn a little upward upon the front of the tarsus, leaving a somewhat gaping wound upon the conjunctival surface which soon heals by granulation. In a few instances I have observed the growth of somewhat exuberant granulation-tissue in the tarsal wound, forming a pedunculated fungoid

mass of small size, such as may be observed occasionally after operations for strabismus and enucleation of the globe; this is easily snipped off with scissors and gives no further trouble.

In a considerable number of cases of lid-contraction following trachoma, the operation of *tarsotomia* should be preceded by that of division of the outer canthus, together with the external tarsal ligament of the upper lid. This canthoplastic operation may sometimes be combined with the *tarsotomia*, but should oftener precede it by a few weeks, so that its effect may be correctly estimated.

It often occurs to the ophthalmic surgeon to treat cases of trichiasis or entropium in which a prior operation has failed to afford perfect or lasting relief, even though a large part of the skin of the eyelid has been sacrificed. In such cases, in which no further removal of skin is admissible, I have obtained excellent results by simply incising the tarsus as already described, and dissecting a little way upon its anterior surface, between tarsus and muscle; a few sutures, taking up a broad fold of integument and perhaps of muscle also, suffice to hold the separated lid-margin in its new position for a day or two, after which the sutures may be removed, and, if thought necessary, a collodion-dressing may be applied.

Dr. Buller: Mr. President, the operation which Dr. Green has described as his modification of Von Ammon's operation, I think has been practised by Von Burow very extensively. Von Burow has described his success with that operation, and states that he has operated one thousand times exactly in that way, cutting through the tarsal cartilage as far as the skin, and then taking out a small piece of skin above the line of incision internally. I myself, three years ago, had an opportunity of practising that operation, and I have done it some dozen times, and I find it very successful in a certain class of cases—that is to say, in eminently chronic cases, in which there is no further tendency to contraction of the cartilage. The process which has produced the incurvation of the cartilage must have run its course; and there must be no spasm of the eyelid, otherwise the operation does not suffice to afford permanent relief, and the incurvation again recurs after some weeks or months have elapsed.

Dr. Smith, of Detroit: Mr. President, I had the pleasure some three years since of seeing a case on which Dr. Buller had operated in the Royal Ophthalmic Hospital, and since my return home I have operated on a number of cases in the same way during the past two years, and can testify, as does Dr. Green, to the success of the operation. With regard to the inflammatory process still going on, my experience has differed from Dr. Buller's. I have seen cases where there has still existed some inflammatory action, that were apparently relieved, though I must say that I have not been able to follow these cases up for a longer period than three months.

The President then announced the next paper.

ON BONY FORMATION IN THE PLACE OF THE LENS.

By P. D. KEYSER, M. D., of Philadelphia.

Bony formations within the eyeball, although not very rare, are still of such interest to the ophthalmologist that I present the following rather rare case:

H. P., aged eighteen years, consulted me in 1874 in regard to wearing an artificial eye on the left ball, the sight of which he had lost when he was a small child. He thinks he was hurt. There has been some inflammatory action in it three or four times, which never continued for any length of time.

Upon examination, I found the cornea flattened, opaque, and atrophic. The remaining parts of the ball normal; T—1. No hardness could be felt in the posterior part of the globe.

The ball being still quite full, it would hardly admit of a good shell, and also fearing the irritation which might arise from its rubbing the cornea, I advised abscision of the cornea to form a better stump for the adaptation of an artificial eye, to which operation the patient consented.

On removing the cornea and ciliary body, I found in the place of the lens a hard, yellowish-white substance, of the same circumference and thickness as the lens, and removed it. The iris was lying against and in some parts attached to the cornea. The vitreous was clear and of ordinary consistence. Very little of it was lost in the operation.

The edges of the wound were brought together by sutures in the bulbar conjunctiva, according to Knapp's method. The wound healed kindly and quickly, and an artificial eye has been worn ever since.

On examining the substance removed from the situation of the lens, it was found to be about the size of the lens, excepting the thickness of the periphery, which was somewhat thinner or flatter, with an irregular edge. I at first supposed it to be a calcareous lens, and was about throwing it away, when it occurred to me to scrape and cut it, and I found that it was not stony, but rather yielded to the blade. This determined me to examine it more minutely. For this purpose it was cut in two with a fine thread saw (it cut and smelt like bone during this act). One-half was placed in a decalcifying solution of chromic acid for the proper length of time, and then microscopical sections were made, stained, and mounted, from which it is to be seen that the substance is bone. The lacunæ, and Haversian canals, with their lamellar systems, are well defined.

In presenting this case, I do not lay it before you as a bony formation of the lens itself, for I doubt that such a metamorphosis can take place, although Knapp, in the *Archives of Ophthalmology and Otology*, vol. ii., No. I., page 2, says: "I think the possibility of ossification in the lens cannot be denied, but its occurrence must certainly be very rare. It is incontestable that formation of connective tissue within the lens may take place. Since connective tissue is capable of ossifying whenever it exists, it may do so in the lens."

I present it, therefore, as a rare form of ossification in the eye; and, as far as I can learn, only two cases are reported where the bony formation had the size and shape of the lens occupying its place. (*See* Förster, "Atlas der Mik. Path. Anat.," Taf. xxxv., and Wagner, Göttinger Anz., 1851.)

There are several descriptions of thin, bony plates in the anterior vitreous and behind the lens, but none of the above-mentioned form, etc., excepting the two of Förster and Wagner.

There was no capsule to be seen, and I have no doubt that from the injury inflammatory action was set up in that membrane and the surrounding parts, and, as the lens was absorbed, connective tissue was formed filling its space, that eventually ossified.

I desire to place this interesting case on record, and lay before you one-half of the bone, and some microscopical sections for your examination.

Dr. KNAPP: This announcement of a bony formation in the lens is startling, as true ossification has never been met with there. Were there bone-corpuscles and Haversian canals present?

Dr. KEYSER: Yes, they are all there, and the microscopic specimens are before the Congress for examination.

Dr. KNAPP: And it was in the lens?

Dr. KEYSER: No, I do not think it was in the lens itself, but in the place of the lens.

The PRESIDENT: Of course, these can only be tested by microscopic examination. It is a very remarkable thing, if such is the fact, even if it is within the capsule and has nothing to do with the transformation of the lens substance.

Dr. GREEN: There are some cases reported of bony formation in the place of the lens, but no one has ever found any ossification of the lens itself; and it is rare to find bone in that position.

Dr. KNAPP: Ossification in the interior of the eye has been met with in a transverse septum, passing across the eye behind the lens. To the centre of this transverse septum the rest of the vitreous inclosed by the detached retina is applied. In this place bone formation is found, while the lateral parts that connect with the periphery of the ciliary body are not yet ossified. Dr. A. Pagenstecher, in a recent paper, has also described this septum across the eye, yet without mentioning the formation of bone. Ossification is sometimes found in the centre of this septum, immediately behind the lens. In some cases the lens is preserved, and in others it is absent. The lens itself is a tissue so poor in nutritive material that it is hard to believe that there can be here any bony formation possible. We meet sometimes on the posterior surface of the anterior capsule with an exudation which resembles true connective tissue, which frequently undergoes chalky degeneration, and then resembles, to a certain degree, bone tissue. There are no any Haversian canals in it. I do not think that true formation of bone has been described to our satisfaction

except in the transverse septum. I should be very happy if Dr. Keyser would give a detailed description of this case so that we may be convinced.

Dr. KEYSER: I do not say this is a bony formation of the lens. It was lying in the position of the lens. It was the first case of the kind I ever saw.

The PRESIDENT: There was no bony formation anywhere else?

Dr. KEYSER: No, sir.

Dr. ALT: We find very often in cataract extractions spots where the exudation is transformed into connective tissue. Afterward it is found not only that calcification has taken place here, but I have one specimen where there is bony formation in the lens capsule; however, I have no doubt that it is not a bony formation of the lens matter, but simply an ossification of the exudation in the wound. Such a case might lead to the opinion that there is ossification of the lens.

Dr. BURNETT then read a paper on "Trachoma as influenced by Race."

A NOTE ON TRACHOMA AS INFLUENCED BY RACE.

BY SWAN M. BURNETT, M. D., WASHINGTON, D. C.

THERE are other circumstances, aside from contagion and bad hygienic surroundings, that contribute to the generation and propagation of this malady, so destructive to the vision of the afflicted, and so exhausting to the patience of the practitioner. A certain influence has been attributed to climate, and there are districts that are said to be comparatively, if not absolutely, free from the disease, owing, as has been supposed, to their climatological characteristics. Schwalbe, in some "Climatological Notes," published in *Zehender's Monatsblätter* for August, 1866, makes mention of the extreme rarity of the disease in Costa Rica and Panama, and institutes a comparison between the climatic condition of these countries and that of the northern portion of Switzerland, where

the disease is equally rare. Saemisch, in his treatise on the subject in the "Hand-book of Ophthalmology," calls attention to the increase in the extent of the disease along the valley of the Rhine, from its source toward its mouth. Mountain-ranges seem, according to him, to oppose no barrier to the spread of the affection.

There is another influence, however, which, although it has been accorded a mere mention by several authors, has not, it seems to me, been considered with that attention which its importance demands. I allude to the influence exercised by race, and even by nationality.

We have not the data at hand to give anything like accurate statistics, but no one who has visited the eye clinics in America, and those of the various European countries, can fail to be impressed with the idea that some nations are much more troubled with the disease than others. An American practitioner, on visiting Moorfields, must certainly be struck with the small number of trachoma cases presenting themselves at that immense charity in comparison to the large percentage of similar cases among the eye patients he sees at home. In France he sees more than in England, and in certain parts of the German Empire more than in France. The Irish, as is well known, suffer immensely. Naturally we would suppose that the poor of London, owing to their extremely bad hygienic surroundings, would suffer more from this disease than those of the same social position in Paris, where the hygienic circumstances are infinitely better; yet, according to my observation, extending over several months in the two cities, trachoma is a much more common disease among the Parisians than among the Londoners. That this is not altogether due to the matter of climate, and that nationality exercises at least a predisposing influence, is proved by the fact that the Irish, wherever they go, carry this proclivity with them, and generally scatter the seeds of the disease along their path. I think an examination of the records of our eye clinics will show that a majority of the patients affected with trachoma are of German or Irish extraction, though the American—so called—is indeed far from exempt from the disease.

But the principal point to which I desire to call the attention of the members of this Congress is the rarity of the occurrence of trachoma among the negroes in this country. I have not been able to find, in searching the records of the profession, so far as I have them at my command, any mention made of this fact, yet, according to my own individual observations, as well as those of other practitioners in my own immediate neighborhood in the South, the negro enjoys an enviable immunity from this disease. I have been practising in the eastern portion of the State of Tennessee for about eight years, among a population one-quarter of whom are negroes, and during that time I have never observed a case of trachoma in a negro, nor have I seen any of the usual results of that disease, such as entropion, nebulous cornea, etc.

This immunity I am unable to refer to any cause except that of race, since the disease is exceedingly common among all classes of the whites. Several endemics of the disease have swept over that particular section, and left their unmistakable marks in the form of entropion, corneal troubles, etc., which are visible to this day, and the disease itself at present forms a large percentage of the cases presenting for treatment among all classes of the white population—the well-to-do as well as the poor. One of the most severe of these endemics can be traced back to the time when a railroad was being constructed through that end of the State, a large body of the laborers on which was Irish. This freedom from trachoma I have found to extend also to the negroes of mixed blood. The hygienic condition of the negro, as a rule, I will state is far from being good. They generally live in crowded quarters, are commonly badly fed and clothed, and are by no means overcleanly in habits.

I have not had the opportunity of comparing my observations in this matter with my *confrères* practising in other States of the South, and do not know how far their experience will corroborate my own. I only give this as the expression of my own observation in the district where I labor, and I should be glad to have an expression from those whose fields lie in other portions of the late slave States.

The President: I have been in the habit for many years

of treating annually a great many cases of trachoma, and I remember but very few cases indeed among negroes. Blepharitis, and all those diseases peculiar to strumous individuals, are very common among them, and sometimes destructive to the eye, leading to ulceration of the cornea, and subsequent staphyloma and various other diseases; but, of genuine granulated eyelids, I scarcely remember to have seen a single case in the negro.

Dr. Noyes, of New York: We do not have that happy exception in the city of New York among the negroes. They come into our institutions, and we commonly have a few specimens of trachoma in the negro present at all times.

THE RELATIONS OF BLEPHARITIS CILIARIS TO AMETROPIA.

By D. B. St. JOHN ROOSA, M. D., N. Y.

It is a well-recognized fact that certain forms of conjunctival inflammation arise from uncorrected errors of refraction. I do not think it is so generally conceded that blepharitis ciliaris often stands in the same relation to ametropia. The principal text-books do not give any prominence to the subject, either in the discussion of blepharitis or ametropia. Most, if not all of them, are silent upon the subject. Donders does not, I think, even allude to blepharitis as one of the results of uncorrected strain of the accommodation. In the chapter on "Blepharitis" in Saemisch's "Handbuch," by Prof. Michel, the subject is not mentioned. Schweigger, in his "Handbuch," is also silent upon this point. The same may be said of the treatises of Wecker, Stellwag, and Soelberg Wells. I mention these omissions because, in speaking of the causal connection of blepharitis with ametropia to some of my professional friends, I found them under the impression that the subject had already been fully dwelt upon in the text-books. However much may have been said upon the subject in the

practice of eye infirmaries and hospitals, very little has as yet found its way into the literature of ophthalmology.

I present, therefore, a few statistics as to the connection between diseases of the hair-follicles and tarsal glands and the various forms of ametropia. They are cases observed by me in private practice during the last eighteen months. I have also attempted to keep a similar record in the Manhattan Eye and Ear Hospital; but there are some omissions in these statistics—that is, the refraction has not been noted in all the cases—I have not therefore placed them among my private cases. I will simply say that, so far as they go, in the opinion of the House-Surgeon Dr. Cheatham, they confirm the results of my own statistics. My conclusions are as follows:

1. Ametropia seems to be the condition of most eyes affected with blepharitis ciliaris.

2. When the blepharitis is associated with errors of refraction the cure of the edge of the lids is very much facilitated by and sometimes depends upon correction of the ametropia.

3. Paralysis of the accommodation by the use of atropia will usually, with no other treatment, very much relieve the blepharitis that is associated with ametropia.

4. Patients suffering from blepharitis that is associated with ametropia will often ignore any other affection of the eyes than that of the edge of the lids, and deny that they suffer from asthenopia or conjunctivitis, complaining only of the discomfort and disfigurement produced by the disease; and this when the error of refraction is so marked that we would naturally expect quite serious consequences from its non-correction.

5. The form of blepharitis to which my statistics refer is not a mere irritation of the edge of the lids, such as often accompanies a catarrhal conjunctivitis, but a true hypersecretion of the tarsal glands and hair-follicles, with the formation of crusts, and sometimes the development of ulcerations.

6. Hypermetropia is the error of refraction, most frequently associated with blepharitis ciliaris.

I frankly admit that the number of cases that I am now able to present does not absolutely prove that blepharitis ciliaris is very frequently caused by ametropia, although I cannot escape the conviction that this is the case. The number is large enough, however, to show a remarkable coincidence at least, and to stimulate others to inquiry in the same direction.

Case I.—Mr. R., aged seventeen, complains of blepharitis, which he has had three to four years. Sometimes has slight pain in eyes after reading.

A. and muscles normal.

Refraction: Emmetropic. V. = 1.

Case II.—Mr. D., aged twenty-six, has had blepharitis and asthenopia for past three years. Complains chiefly of the blepharitis. Has derived no benefit from treatment, which has been from competent surgeons, who have not prescribed glasses.

A. and muscles normal.

Refraction: Mixed astigmatism, both eyes.

Under atropine—

R. E., with $+ \frac{1}{42}$ c. $\sqsubset - \frac{1}{42}$ c., V. $= \frac{20}{20}$.
L. E., with $+ \frac{1}{24}$ c. $\sqsubset - \frac{1}{36}$ c., V. $= \frac{20}{30}$.

Ordered above glasses; also, cleansing of lids with sol. bicarbonate of soda in water, and application of red oxide of mercury ointment.

Patient reports six months later: Uses eyes with comfort, and has scarcely any blepharitis. Says that redness of lids returns whenever he leaves off his glasses for a few days. Four months later, lids are entirely well.

Case III.—Miss G., aged eighteen, has had asthenopia and blepharitis since childhood.

A. and muscles normal.

Refraction: Comp. hypermetropic astigmatism, both eyes.

Under atropine—

R. E., V. $= \frac{20}{70}$. With $+ \frac{1}{36} \supset \frac{1}{36}$ c., V. $= \frac{20}{20} -$.
L. E., V. $= \frac{20}{70}$. With $+ \frac{1}{36} \supset \frac{1}{36}$ c., V. $= \frac{20}{20} -$.

This patient was freed from the blepharitis, etc., by the glasses.

Case IV.—Miss W., aged fifteen, complains only of blepharitis. V. = 1.

Refraction: Hypermetropia, $\frac{1}{36}$ both eyes. Result of treatment unknown.

Case V.—Mrs. F., aged twenty-eight, complains of blurring of distant vision, of fatigue in eyes after use, and of blepharitis.

A. and muscles normal.

Refraction: Myopia, $\frac{1}{42}$ R. E., and $\frac{1}{48}$ L. E. V. = 1.

Ordered $-\frac{1}{60}$ for both eyes.

Four months later, reports herself entirely well.

Case VI.—Mr. D., aged twenty-three, has had blepharitis and styes for past two years. Some asthenopia for past six months.

A. normal. V. = 1.

Insufficiency recti interni 6° at 12″ and 4° at 15′.

Refraction: Emmetropic. No record of treatment or course.

Case VII.—Mr. V., aged twenty-eight, complains of blepharitis. V. = 1.

Refraction: H $\frac{1}{48}$ both eyes.

After declining glasses for nearly a year, with constant relapses, is now wearing + $\frac{1}{60}$ with evident progress on the cure of the blepharitis.

Case VIII.—Mr. W., aged twenty-eight. Blepharitis and asthenopia past two years.

A. normal.

Refraction: Compound myopic astigmatism, both eyes.

R. E., with $-\frac{1}{48}\bigcirc-\frac{1}{24}$ c., V. = $\frac{20}{20}$.
L. E., with $-\frac{1}{48}\bigcirc-\frac{1}{42}$ c., V. = $\frac{20}{20}$ —.

Patient not heard from since glasses were ordered.

Case IX.—Mr. D., aged twenty-eight, complains of blepharitis. Has had it four or five years.

Refraction: H $\frac{1}{36}$ both eyes. V. = 1.

Case X.—Mr. J., aged thirty-six, complains of blepharitis, which he has had for several years.

A. and muscles normal.

Refraction: Simple myopic astigmatism, $\frac{1}{48}$ both eyes. V. = 1.

Case XI.—Mr. B., aged twenty-eight, complains of "gritty" sensations about eyes, and of blepharitis.

Refraction: H $\frac{1}{24}$ both eyes. V. = 1.

One month after, this patient was greatly relieved of his symptoms.

Case XII.—Mr. A., aged twenty-three, complains of indistinct vision, and of blepharitis.

Refraction: Simple hypermetropic astigmatism, $\frac{1}{18}$ each eye. V. = $\frac{20}{50}$.

Relief, but not cure, from treatment.

Case XIII.—Miss C., aged fifteen, complains of blepharitis.

Refraction: Hypermetropia, both eyes.

Declines to wear glasses.

Case XIV.—Master U., aged ten, complains of blepharitis and asthenopia.

Refraction: H $\frac{1}{8}$ each eye.

R. E., V. = $\frac{20}{30}$ —.
L. E., V. = $\frac{20}{50}$ —.

The glasses caused some improvement, but the patient was seen but twice or three times after they were prescribed.

Case XV.—Miss C., aged sixteen. Blepharitis since a small child. Treated at an eye infirmary for a year.

Refraction:

R. E., H $\frac{1}{16}$, V. = $\frac{20}{50}$ +.
L. E., H $\frac{1}{24}$, V. = $\frac{20}{50}$ +.

This patient's blepharitis was very much improved by the continued use of atropine in connection with the usual treatment. She passed from under observation before she was entirely well, and before glasses were ordered for her. Corneal opacities prevented better result from the correction of the hypermetropia, and they had not been ordered when last seen.

Case XVI.—Mr. T., aged thirty-five, complains of having had blepharitis since 1858. Some asthenopia.

A. normal.

Refraction:

R. E., Myopia $\frac{1}{36}$, V. = 1.
L. E., Myopia $\frac{1}{24}$, V. = 1.

Insufficiency of recti interni, — 7° at 12″. Was improved by glasses. Had had the usual local treatment for years.

Case XVII.—Mr. A., aged twenty-four, complains of having had blepharitis for past three years; asthenopia for the same period.

A. normal.

Refraction: M $\frac{1}{42}$ both eyes. V. = 1.

Insufficiency recti interni, 5° at 12″. Went to Europe before benefit from glasses could be tested.

Case XVIII.—Mrs. L., aged thirty-two, has had asthenopia and muscæ for some time. Unable to do any fine work for past two months. Slight blepharitis.

A. and muscles normal.

Refraction: Emmetropic. V. = 1.

This patient is suffering from mental worry, and eyes are but index of whole nervous system. The refraction was tested under atropia.

Case XIX.—Mrs. B., aged fourty-four, complains of blepharitis.

Refraction: Emmetropic. V. = 1. Has presbyopia, $\frac{1}{36}$.

Case XX.—Mr. B. complains of blepharitis.

A. and muscles normal.

Refraction: Slightly hypermetropic by ophthalmoscope. No atropine used. V. = 1. Not seen again.

Case XXI.—Miss L., aged twenty-one, complains only of blepharitis, which she has had over a year.

Refraction: Mixed astigmatism, both eyes.

R. E., with $-\frac{1}{15}$ c. $\lceil + \frac{1}{42}$ c., V. $= \frac{20}{30} -$.
L. E., with $-\frac{1}{15}$ c. $\lceil + \frac{1}{42}$ c., V. $= \frac{20}{30} -$.

This patient's blepharitis was considerably improved by the use of atropine for two or three weeks, while the refraction was being accurately determined. She passed from observation almost immediately after the refraction was determined. There were evidences of old iritis in her case.

Case XXII.—Miss P., aged five. Mother states that she has had blepharitis for the past eighteen months, and she now has marked affection of her lids.

Refraction: H $\frac{1}{24}$ both eyes. V. = 1.

Owing to youth of patient, none but local treatment was advised until she should begin to study.

Case XXIII.—Mr. R., aged twenty-one, has had asthenopia and blepharitis of L. E. for past eighteen months. Blepharitis in R. E. past three months.

A. and muscles normal.

Refraction: H $\frac{1}{36}$ both eyes. Ordered $\frac{1}{42}$. V. = 1.

Case XXIV.—Master E., aged twelve and a half, complains of having pains in eyes occasionally, and of blepharitis.

Refraction: M $\frac{1}{48}$ L. E. M $\frac{1}{6}$ R. E. Choroiditis.

Case XXV.—Master F., aged six, has had blepharitis several months.

Refraction: Emmetropic by ophthalmoscope. Atropine not used. Local treatment advised.

Case XXVI.—Mr. M., aged twenty-one. Blepharitis for past year. Has had a good deal of treatment, but without benefit.

A. normal.

Insufficiency recti interni, 4° at 12″.

Refraction: M $\frac{1}{48}$ both eyes. V. = 1.

Case XXVII.—Miss N., aged thirteen. Blepharitis since a small child. Has been treated frequently, but never permanently cured. Some asthenopia after prolonged use of eyes.

Refraction: H $\frac{1}{30}$ both eyes. V. = 1.

Case XXVIII.—Miss S., aged twenty-five, has had blepharitis and asthenopia for five years.

A. and muscles normal.

Refraction: Compound hypermetropic astigmatism, both eyes.

R. E., with $+\frac{1}{36}\bigcirc+\frac{1}{48}$ c., V. = $\frac{20}{20}$.
L. E., with $+\frac{1}{36}\bigcirc+\frac{1}{48}$ c., V. = $\frac{20}{20}$.

Ordered above glasses. No local treatment for lids.

Patient reports four months later: Asthenopia is entirely relieved and blepharitis has disappeared.

Case XXIX.—Mr. C., aged twenty. Asthenopia two years. Quite severe blepharitis for same period.

Refraction: Compound hypermetropic astigmatism, both eyes.

Under atropine—

R. E., with $+\frac{1}{48}\bigcirc+\frac{1}{6}$ c. axis 90°., V. = $\frac{20}{50}+$.
L. E., with $+\frac{1}{42}\bigcirc+\frac{1}{42}$ c. axis 90°., V. = $\frac{20}{20}$.

Case XXX.—Mr. C., aged thirty-nine, complains of blepharitis. Has had slight asthenopia in the evening, but is only annoyed by the redness of his lids.

Refraction: Slightly hypermetropic in both eyes by ophthalmoscope. $\frac{1}{\infty}=\frac{1}{40}$.

Ordered $+\frac{1}{40}$ for reading. No other treatment.

A month later, lids looked better, but not entirely well.

Case XXXI.—Master W., aged twelve. Blepharitis past four years. Has been treated by usual remedies, but never cured. Has asthenopia. Palpebral conjunctivitis in mild form.

Refraction: H $\frac{1}{48}$ each eye, under atropine.

Summary.

Cases reported..... 31
Complained of blepharitis alone.....15, or about 50%
Complained of blepharitis and asthenopia..... 16
Cases having refractive error.....26, or nearly $83\frac{9}{10}\%$
Cases of emmetropia.....5, or about $16\frac{1}{10}\%$

Hypermetropia	13
Myopia	5
HAs	1
MAs	1
H. + HAs	3
M. + MAs	1
Mixed astigmatism	2
Emmetropia	5
	31

Mr. Carter: I must say that, judging from English experience, I should look upon this combination of blepharitis with ametropia as being a matter of coincidence, rather than a matter of causation, and possibly the influence which has just been described to us by Dr. Burnett, the possible influence of race in producing trachoma, may have some influence in producing blepharitis in this country, for it is certain, as far as my experience goes, that we do not meet with blepharitis at all among the better classes. We meet among them with plenty of ametropia and plenty of asthenopia, but we do not meet with blepharitis. I think that, in the course of eighteen or twenty years, I could count upon the fingers of one hand all the cases of blepharitis ciliaris that I have seen in my private practice; whereas, in hospital cases, my friend, Mr. MacHardy, is in the habit of giving them instruction for local treatment half a dozen at a time, there are so many of them. At St. George's Hospital and the South London Ophthalmic Hospital we get more blepharitis than we do in a neighborhood inhabited by the better class of population. I am at a loss, therefore, to connect these two things, although I must say we are quite familiar in England with the fact that very obstinate cases of conjunctivitis depend upon ametropia.

Dr. Robertson: Mr. President, I can thoroughly corroborate the remarks that have just fallen from Mr. Carter, that blepharitis ciliaris is scarcely known among the better class of the population of Great Britain; whereas, among the poorer class, it is one of the most common of complaints. At the same time, I can also corroborate the statement that fell from Mr. Carter that, in cases of ametropia, especially in cases of

hypermetropia, we generally have an obstinate form of inflammation of the conjunctiva, and that, I can imagine, in a population in which blepharitis may be preëminent, may produce blepharitis ciliaris; whereas, with us, where blepharitis ciliaris among the upper classes is rare, we have simply chronic conjunctivitis of the lids; but I have had pointed out to me the connection which almost invariably exists between long-continued cases of ametropia (cases of ametropia that have for a long period not been corrected by suitable means) and the condition of chronic conjunctivitis—a form of conjunctivitis which resists all treatment until the ametropia is corrected. Among the poorer classes and those in poorer circumstances, where cleanliness is not so much attended to as in the upper classes, we have an abundant supply of blepharitis ciliaris, but certainly not in the upper classes; showing that, although in the upper classes, of course, ametropia is quite as frequent as in the lower classes, there is not that connection between blepharitis ciliaris and ametropia which Dr. Roosa has pointed out—at any rate, it does not hold good in our country—but that there exists a connection between inflammatory affections of the conjunctiva of the lids and ametropia is certainly borne out by our experience in Great Britain.

Dr. Roosa: I was prepared for just the statement that has been made, but I am still not convinced, because I have seen in the poorer classes of New York also quite a number of cases of blepharitis ciliaris which were unrelieved by any of the treatment which was done in the manner that has been suggested by Mr. Carter; and if the gentlemen will do me the favor when they go back to London and to Edinburgh to pay a little more attention to the results of the treatment in the poorer classes as to the blepharitis ciliaris, then I think they will find that there is something more than a coincidence. While I was careful to state that I did not believe that the error of refraction causing it was the sole cause, I put it as one of the predisposing causes, and as one of the exciting causes, as has been noticed very briefly by others; but I do not think that they have settled the point that there is no connection simply by stating that it only occurs among the poorer classes. I would also remark that we are all here fa-

miliar with the observation that hypermetropia causes conjunctivitis. From these twenty-eight cases I have excluded all in which there was conjunctivitis. I have stated cases in which the only difficulty was the inflammation of the lid, and in the large majority of cases that trouble could not be relieved by any treatment directed to the edge of the lids alone. I believe that the gentlemen will find the same state of things occurring even among the poorer classes. I have examined the refraction of every patient that presented himself at the Manhattan Eye and Ear Hospital for some months, and the same proportion exists as here, and those children do not get well unless atropia is used, and in some cases glasses are also prescribed.

Dr. Keyser: I wish to corroborate the experience of Dr. Roosa in my practice in Philadelphia. Two years ago I had two cases of blepharitis, which no treatment seemed to relieve. I examined the refraction, and since then I make it a point to examine the refraction in every case, and in a large majority of cases I find hypermetropia.

Dr. Thompson, of Indianapolis: In regard to the statement that blepharitis occurs in none but the indigent, I can remember cases in affluent families where it was hereditary on the mother's side, nearly all the children being subject to it. In another case, the father has it and the others have not; and those are in affluent circumstances.

Mr. Carter: With your permission I should like to mention one more point that occurs to me, and that is that in London an enormously large proportion, I should say at a guess eighty per cent., of our cases of blepharitis are in young children before the time of life when any serious strain from ametropia is thrown upon the eyes.

Mr. MacHardy, of London: Mr. President, the absence of blepharitis among the better classes, as they present themselves to ophthalmic practitioners, is explained by the fact that many of these patients are placed first of all under the care of their family physicians, who, in the better class of practice, are sufficiently educated to treat blepharitis successfully; but, in the poorer class of patients who present themselves in, I am sorry to say, such numerous hundreds in the

hospital I am connected with, this class of patients does not recognize the importance of blepharitis when it first occurs, which, as Mr. Carter has just mentioned, is nine out of ten in children of four or five years of age, shortly after measles. The affection is then neglected; they are taken then, if at all, to indifferent general practitioners, who fail to cope with the malady; the case runs from bad to worse; and thus the great mass of cases that present themselves in the lower classes of society. My own impression, from having at one time practised generally in the country, is, that the affection is equally common in all classes of society, but more severe and more generally seen by the ophthalmic surgeon pure and simple in the poorer class, for the reason that it is neglected or not properly treated in that class of society, owing to the indifferent education of the practitioners to whom the patients are first submitted.

Dr. Risley: In reference to this point, I have just been tabulating cases of blepharitis associated with ametropia. I have been engaged in this now at intervals of leisure for a month or more. I cannot give my numbers accurately, for I do not remember them, and my tables are not yet completed; but my experience simply corroborates that of Dr. Roosa. In fact, excluding a certain number of young children in the lower class, I am almost convinced that so many cases of blepharitis in adults are so many cases of ametropia. In fact, in my practice, I am in the habit of telling them that they need a correcting glass; that the ointment given them to anoint the edges of the lid night and morning will cure them for the time being, but the moment they desist from its use the blepharitis will occur again. I have many patients now who are supplied with the ointment with which they regularly anoint the edges of the lid, and I am convinced that there is a direct connection, and not coincidence, between ametropia and blepharitis. In my experience in Philadelphia it has not been confined to the lower classes.

Dr. Thomson, of Philadelphia: This is quite my own opinion in regard to blepharitis, and it has been so for some time; and, indeed, I have been sometimes surprised to discover a case of chronic blepharitis in which there is no opti-

cal defect. I am in the habit of being quite impressed by a case of blepharitis, where the inflammation of the lids can be readily relieved by the simple application of one of the ointments that we are in the habit of using.

The President then announced the next paper.

ANALYSIS OF 1,079 RECORDED CASES OF AMETROPIA AND MUSCULAR WEAKNESS, WITH DEDUCTIONS RESPECTING ASTHENOPIA.

By HENRY D. NOYES, M. D., New York.

That investigation into the causes and treatment of asthenopia has not yet become superfluous will be admitted, I think most readily, by those who have had the most experience. What has been done by Donders in describing hypermetropia and astigmatism, and by Graefe in teaching us the theory of muscular abnormities, gave us the salient points of a territory which before their time had been most imperfectly mapped out. Yet many minor features have been left undetermined and some regions imperfectly explored. In reference to a certain class of cases distinguished by great pain, and which presented also the typical picture of asthenopia, Mauthner (Bd. ii., p. 420) says that he could discover neither accommodative nor muscular trouble, and, having found all remedies against affections of the retina and ciliary nerves powerless, he was left at a loss to know what to assign as the cause of the affection or what to suggest for a remedy. At page 290, Donders says of a case, which he calls "apparent" as distinguished from "true asthenopia," that it represents "a not well-explained form of hyperæsthesia in connection with symptoms of congestion." Again, Mauthner (p. 414) says, that he has seen so many cases which manifested both accommodative and muscular asthenopia, and which found small or no relief either by convex glasses or prismatic glasses or by convex-prismatic glasses, that he desires no increase of this material for observation.

The investigations whose results are now reported embrace 1,079 cases which have occurred in private practice. For 828 of them I have kept a printed form which includes the details both of refraction and muscular conditions, as well as other general data. Not always have all the items been actually filled in, but in many cases where no record has been entered an examination has been made into details which the records do not show; while a system of study has been followed which has led to valuable conclusions in my own mind. What these conclusions are I shall set forth, and show, so far as I can, the data from which they are derived.

I can use the word asthenopia only in a general sense, as a generic term, not as being in itself a disease. Donders attempted to fix a definite meaning to the word by applying it exclusively to that class of painful vision dependent on hypermetropia (*see* p. 262). But he departs from the rigor of his definition by saying (p. 593) that, "with paresis of accommodation, asthenopia very quickly occurs." He also says (p. 514) that in cases of astigmatism "psychical fatigue is soon created, with which, under some circumstances, as the result of the excessive tension of accommodation, phenomena of asthenopia are combined." He employs the term muscular asthenopia, and thus he finds it impracticable to narrow the term to the cases only of hypermetropia. In fact, the word has become current as a generalization to distinguish those cases in which use of the eyes is painful or difficult, and in which there is no idiopathic inflammation nor any opacity of the media. Amblyopia may complicate it, and may be a cause of asthenopic symptoms.

It becomes necessary, therefore, to subdivide the cases of asthenopia into the several classes or species which it includes. It is true that opacity of the cornea, incipient cataract, posterior synechia, a turbid vitreous, or any slight retinal or choroidal affection (amblyopia), may cause asthenopic symptoms, but, so soon as the facts are fully discovered, the case is placed in its proper category. By not attempting to rigidly define asthenopia, we preserve a convenient word, and do not introduce confusion in nomenclature. We may not, however, credit ourselves with any more completeness of understanding,

in calling a given case asthenopia, than our predecessors could arrogate, when for affections of the fundus oculi they used the term amaurosis. Both terms are generic, and both demand an answer, What kind of asthenopia, or what kind of amaurosis?

I feel justified in taking this wide latitude, because my standpoint in this paper is purely clinical. I bring the results of daily observations on patients who came to me to be cured. My object was to find remedies—and I may again quote Donders (pp. 274, 275): "With our defective and imperfect notions, science can, with respect to therapeutics, at the most, occasionally suggest what deserves by preference to be submitted to investigation, and that her further duty is to endeavor to explain what has been ascertained."

Before attempting to isolate the various kinds of asthenopic cases, I will relate the *symptoms* which usually do or may arise.

1. The cardinal symptom is pain. It may be acute or dull; it may arise only in using the eyes or it may be permanent; it may attend the first effort at use or it may occur after the lapse of a certain time; it may be present at certain times only, as during the latter part of the day, or week, if Sunday be observed as a day of rest, or during menstruation; it may accompany attention to or looking at any object near or remote, and therefore be permanent; it may be aggravated by bright light; it may be felt during the night if the patient wake from sleep; it may be called by different names, as "aching," "a tired feeling," "weariness," "soreness," "inability to look at anything," "a horror of print," "acute pain," "dull pain," etc., etc. The seat of it may be in the eyeballs, along the supraorbital nerves, deep in the orbit; in the inner angles of the eyes, in the forehead, occasionally neuralgia of the face, and very frequently headache; oftentimes any movement of the eyes is painful, and I have already said that sustained fixation may be painful. Looking at rapidly moving objects, like machinery, or persons dancing, or out of the window of a railway carriage, is a frequent occasion of pain. The most common occasion of pain is looking at near objects, like reading, or sewing, or writing, and I have named the occupa-

tions in the order in which they are most likely to cause pain; the minuter kinds of handicraft and drawing will naturally cause the same symptom. Pain is produced, we are sometimes told, by moving the eyes across the page and by looking up or down, or to extreme lateral positions.

2. Next in frequency come sensations of smarting of the eyes, the feeling as if something were under the lids, sometimes lachrymation. To relieve the feeling, patients rub or press on the eyeballs, and often suppose that a slight inflammation is the origin of all their distress. In this opinion they have too often been confirmed by the mistaken judgment of physicians who have discovered congestion of the palpebral or ocular conjunctiva, and prescribed for this without making deeper inquiry or directing the patient to seek competent advice. The presence of palpebral irritation is, in fact, extremely common, as has been noted by Donders, Schweigger, and many others. In my cases, I have noted its occurrence in one hundred and fifty-eight patients, its degree being so notable as to call for remark and often to require treatment. Under the designation of conjunctival irritation, I include blepharitis ciliaris, blepharitis angularis, hordeola, cystic tumors, and phlyctenulæ, as well as congestion of the palpebral or ocular conjunctiva. All these conditions are extremely prone to attend upon asthenopic troubles, and oftentimes will not yield to any treatment local or general until the asthenopic symptoms are relieved. Of course, I am not understood to say that the above irritations always imply the coexistence of asthenopia, but they do so often attend upon it as to demand attention to the refractive and muscular status of the eye in case the local affection prove rebellious to treatment. I would even go so far as to say that in most cases a sufficient presumption is raised in favor of the existence of an accompanying asthenopic cause as to warrant an inquiry into the functions of the eye. I could narrate not a few cases in illustration of this statement.

3. Blur, or confusion, or indistinctness, in reading or writing, etc., is a frequent symptom. Sometimes double vision is complained of, but this is uncommon. In general, it may be said that blur or indistinctness characterizes refractive and accommodative asthenopia, while double vision or absence of

blur belongs to muscular asthenopia. A useful hint may often be gained by careful questioning on this point. Pain without blur suggests muscular trouble, blur followed by pain suggests refractive error; of course, both may be, and I shall show that they often are, combined.

4. It follows, from above statements, that there is always inability for, or discomfort under, sustained effort at near objects.

5. An important symptom is headache. In cases of refractive error, more especially in astigmatism, this may be constant or of frequent occurrence, and independent of use of the eyes. In other cases it is caused by near work, and recognized by the patients as having this relation. In my earlier records I noted this symptom very often, but of late years have become so accustomed to its occurrence as to have frequently omitted to make the record. I find the fact stated in fifty-five cases, and this should not be considered to represent the full proportion of those to whom this symptom belonged. To illustrate the variety of causes which in the cases noted gave rise to headache, the following particulars may be added:

Errors of refraction, including H, Ah, H + Ah, and M, Mh, M + Mh	25
Errors of refraction, with weakness of muscles	9
Spasms of accommodation	3
Weakness of muscles	11
Ocular troubles, with symptoms of congestion of the brain or general ill-health	7
	55

It is evident how large a proportion belongs to the class of refractive errors. It is true of some of these that other bodily disorders, such as uterine disease, or curvature of the spine, or general debility, had a share in causing headache, but the dominant influence of the eye trouble in this regard was manifested by the marked relief which the proper glasses afforded. In most cases the relief was complete and permanent, in a few cases it was imperfect or temporary.

In certain instances there were concurrent signs of con-

gestion of the brain or spinal cord, such as dizziness, a sense of fullness and oppression, slight numbness of the upper extremities, tenderness over the spinous processes, etc., etc. In such cases the head troubles and eye troubles react upon and aggravate each other, and the elimination of the eye troubles greatly mitigates the head symptoms, and may pave the way for the effectual use of remedies suited to their removal. Such cases are among my records, where the selection of glasses, followed by the iodide or bromide of potassium, has set aside severe and obstinate symptoms of cerebral disturbance. The gain to the patient of mental elasticity and vigor is in these cases manifested in the most lively and gratifying way.

Where muscular troubles are the occasion of the headache the cure is usually more gradual, and more often demands the coöperation of proper general treatment with the local appliances:

Case I.—One instance I find signalized was a case of myopia $\frac{1}{6}$, with insufficiency of the interni, and for which tenotomy of the externi was done, with complete relief of the head pain and also of the eye troubles.

Case II.—In another case where congestion of the brain and spinal cord accompanied refractive errors, the order for O. D. — $\frac{1}{48}$ c. 60°, O. S. — 60s, with the administration for six weeks of iodide and bromide of potassium in combination, set aside the distress in the eyes and the pain both in head and back.

I dwell on these cases because they have a direct bearing on the experiences of general practice as well as of the oculist.

Such observations have been made by all who deal much with cases of eye trouble. It was noted by Donders in a patient whom he told that, if she wished to be free from nervous headache, she must wear spectacles. She was hypermetropic, $\frac{1}{36}$ (*see* p. 233). Mauthner (p. 416) has seen pain in the back as well as headache, and these leading to nausea, of which I shall speak.

Dr. J. Weir Mitchell, of Philadelphia (*see American Journal of Medical Sciences*, April, 1876), from his standpoint of observation in diseases of the nervous system, has written an

article embodying his experiences, and acknowledges his obligations to Dr. Wm. Thomson in analyzing his cases. To the general practitioner, it is greatly important to be acquainted with the causal connection which sometimes exists between obstinate neuralgic headache and defects in the structure and function of the eye.

Case III.—Spasm of accommodation may be the exciting cause, as in a medical student, aged twenty-two, whom a distinguished neurologist treated with bromide of potassium for cerebral anæmia. He was working hard for his examination and was sleepless. I found his vision for distance blurred, being only $\frac{20}{100}$—that with $+\frac{1}{12}$ he read Jaeger 1 from $4\frac{1}{4}''$ to $9''$, and could not see beyond it. At $14''$ there was insufficiency of the interni of 6°. By the ophthalmoscope R = E.; the optic nerve a little hyperæmic and papilliform. The use of atropia soon overcame the spasm, restored his refraction to its normal play, removed his headache, and obviated the pain in his eyes.

6. A symptom correlated to headache is nausea. It happens infrequently, and I find it noted in four (4) cases. They were instances both of refractive and muscular errors. The stomach does not become affected in some cases, except after severe headache; at other times nausea is one of the first tokens of overstrained eyes.

7. Intolerance of light is only less frequent than headache. It varies in every degree; from slight degrees of discomfort at any unusual glare it may increase to the most tormenting distress. In the extreme cases the patient is apt to be adjudged to have acute retinitis, and the gravest prognosis to be given as to the future of sight. That these vaticinations are founded in ignorance becomes evident when the true state of refraction and of muscular equilibrium is discovered. I quote two noteworthy cases:

Case IV.—Miss T., aged twenty-eight, a year before consulting me began to have asthenopic symptoms, in which not only was use of the eyes painful, but bright light was annoying. For a time the trouble abated, and then recurred, and she finally became so sensitive to light that she confined herself much of the time in a rigidly darkened room. She began this voluntary imprisonment in July, and had maintained it until the following January, 1865, when she visited me. She present-

ed herself under cover of a wadded green visor or half helmet, which she wore, so as to cover the front of the head and all the upper part of the face, simply leaving the tip of the nose to project. This had always been her protection whenever she went out of doors. It was impossible to inspect her eyes with any degree of light which would be available for my purposes. She resisted all attempts to remove the mask, except on condition of almost total darkness. Even then she shut her eyes, and refused to permit any careful examination. I finally persuaded her to submit to the inhalation of chloroform. I found the corneæ clear, and no other outward sign of trouble but palpebral conjunctivitis. While she was unconscious, the windows were thrown wide open, and, on recovery of her faculties, she forgot her photophobia. The distress was not absolutely cured, but she had no return of her extreme suffering. In a few days she went to her home in the country. After six weeks she returned with a partial relapse. I could at this time make a functional examination, and discovered H $+\frac{1}{48}$, with great weakness of recti interni, the adductive power at twenty feet being 5°, with vertical diplopia, and the abductive power at twenty feet being 12°, with vertical diplopia. The actual capacity for adduction and abduction at twenty feet was not taken. My method of examination at this period, 1865, not having been developed to what I afterward employed, I directed counter-irritation to the temples and mastoid regions, and gave valerianate of zinc. I also directed moderate and increasing daily use of the eyes. A year afterward the condition of patient was one of moderate annoyance, but not of perfect cure. Had I at that time understood how to direct the proper use of prisms, I feel sure that a much happier condition could have been secured.

The case illustrates how muscular insufficiency may develop aggravated nervous perturbations, which, though called hysterical, give rise in the ordinary mind to the most serious anxieties as to the preservation of sight.

Case V.—Another case is that of Mr. W. A. S., aged twenty-seven, whom I saw in 1864, who had from the age of seven years known that his eyes were faulty; at the age of thirteen, which was in 1852, he put on strong convex glasses for constant wear; had found by experience that his eyes felt better in strong light than in moderate light. He took a course of study in college, and used his eyes with no special trouble. During the year 1864 he submitted to a surgical operation on the scrotum, which kept him in bed for several

weeks. He amused himself by studies in mathematics until his eyes entirely gave out. Photophobia was set up, and rapidly increased until he buried himself for two months in absolute darkness. He did this partly by advice of his physician and greatly of his own inclination. The effect on his mind of the trouble of his genital organs was very depressing, so that he took an exaggerated view of his eye difficulties. I found him to have H $\frac{1}{7}$, gave him these glasses, and spent considerable time in encouraging him with assurances that no evil had happened, or was likely to happen, to his sight. He accepted both the glasses and the consolation, returned again to active life, became after a time accustomed to the glasses, regained the use of his eyes, and went to California. Two years later, having used his eyes to excess, he applied to me again for advice. I added to his spherical glasses $\frac{1}{48}$ cylinder, and, after a period of rest, he was again enabled to use his eyes. In December, 1874, I saw him again, and directed—

O. D. + $\frac{1}{4}$ s. — $\frac{1}{42}$ c. 90°. S. = $\frac{20}{20}$.
O. S. + $\frac{1}{6}$ s. — $\frac{1}{36}$ c. 60°. S. = $\frac{20}{30}$.

He came to satisfy his mind that no important change of glasses was needful, and expressed the satisfaction he found in his glasses, and immunity from any disturbing eye symptoms.

Other subjective symptoms occasionally occur in asthenopia, such as, 6, twitching of the lids, 7, sometimes facial spasm, 8, sometimes vertigo.

It has been lately announced by Dr. Stevens, of Albany, that chorea has been found to depend on troubles of refraction and muscularity. On this point I cannot speak with emphasis, because I have found only six cases in which the presence of choraic symptoms is noted. Of these three were typical cases of chorea. One, a young man, seventeen years of age, whose eye trouble was weakness of r. interni, and whose history did not suggest that the eye trouble was anterior to the nervous troubles. Another case was a boy, aged nine, who had H about $\frac{1}{12}$, and pronounced chorea. The boy had been advised to wear glasses, but this had not been done. He had been under treatment with arsenic, and the chorea seemed to be under control of this remedy. I also find recorded in 1868 a young lady, aged twenty, who had chorea, and her vision was O. D. — $\frac{1}{10}$ c. 25° S. = $\frac{20}{30}$ O. S. — $\frac{1}{18}$ c. 10° S. = $\frac{20}{30}$. I do

not know the subsequent history, and never saw her after giving glasses.

In three other cases there were symptoms of irregular muscular action in the muscles of the face. One had nictitation of the lids, another had facial twitch. For two of them glasses were ordered to correct compound myopic astigmatism; and for another, prisms. The ocular disabilities were satisfactorily relieved, but the nervous spasms continued as before. In two other cases, in both of whom the muscular conditions were faulty, there was concurrent mental disturbance: in the one amounting to insanity, in the other consisting of anxiety and gloom because of fancied disorders of his genital organs. That males who have real or imaginary diseases of the genital organs, or who have practised masturbation, should also complain of asthenopia, is not uncommon; but these cases do not belong to the special category now being considered.

On the whole, my observations have failed to discover any causal connection between asthenopia and chorea. If such can by closer research be established, a most valuable contribution will have been made to pathology and therapeutics.

9. To cite strabismus convergens as one of the symptoms of asthenopia may be considered illogical, because it is commonly the device by which the painful action of the eyes is avoided. That is, hypermetropes who squint voluntarily thereby use their eyes without fatigue; but, if they do not squint, they speedily become tired. While this, as taught by Donders, is a recognized fact, it is also true, of some patients who have strabismus, that they have found themselves much more comfortable after an operation has cured the muscular defect than they were before. This is true not only of hypermetropes but also of myopes. I find among my cases the record of seven myopes with strabismus convergens.

Case VI.—One had simple myopic astigmatism, $-\frac{1}{12}$ in each eye, and was operated on for strabismus. Of course, he was afterward provided with suitable cylinders, and it would be impossible to decide whether the comfort which he gained was to be ascribed to the correction exclusively, or jointly to the operation and the glasses.

Case VI.—For another case, a physician, operated upon, who had O. D. $-\frac{1}{5}$ s. $-\frac{1}{48}$ c. O. S. $-\frac{1}{5}$ s., each eye V $=\frac{20}{20}$, and who had worn

glasses, there was in his mind no doubt that the operation had been a great gain to his capacity for eye work. The other three cases were not operated on. One enjoyed good vision with each eye alternately, having O. D. $-\frac{1}{5}$, O. S. $-\frac{1}{4\frac{1}{2}}$ s. Another, having O. D. $-\frac{1}{4\frac{1}{2}}$ s. $-\frac{1}{1\frac{1}{2}}$ c. 125° O. S. $-\frac{1}{7}$ s. $-\frac{1}{1\frac{1}{2}}$ c. 170°, has binocular vision with glasses, and by them is relieved both of asthenopia and strabismus. Another, having O. D. $-\frac{1}{2\frac{1}{4}}$ c., V $=\frac{2\,0}{2\,0\,0}$, with congenital anterior polar cataract, O. S. $-\frac{1}{5}$ s., V. $=\frac{2\,0}{3\,0}$, formerly had strabismus, but from it is now quite free. Another case was a girl, aged seven, having in each eye $-\frac{1}{7}$ s. and V. $=\frac{2\,0}{5\,0}$; and another (Case VII.), a lady, aged twenty-two, who had worn glasses since she had been seven years old. The eyes were deep in the orbits, the convergence decided; the left eye was but little used. O. D. $-\frac{1}{2}$ s., V. $=\frac{2\,0}{1\,0\,0}$. There was choroidal atrophy for a space around the whole optic nerve. O. S. $-\frac{1}{2}$ s., V. $=\frac{2\,0}{2\,0\,0}$, with a still more extensive circum-optical atrophy of choroid, and beginning atrophy of macula lutea. The excessive myopia and the depth of the globes in the orbit, as well as the converging strabismus, make this case notable.

The above cases seem to me to show that weakness of the externi may be a sufficient primary cause of strabismus convergens in myopia, provided that the myopia be tolerably high and the vision of each eye good. This subject does not properly claim discussion in this connection.

10. An uncommon symptom, which I find noted but twice, is that, after reading, or, in one instance, while sitting at dinner, there should be an attack of total darkness. Its duration was for a few minutes. In one patient it affected only the right eye, in the other both eyes. Both patients were females, and extremely susceptible. In one, photophobia was excessive, and her history might be added to Cases IV. and V. Sudden anæmia of the retina may be well conjectured to be the cause of this phenomenon.

11. If we pass now to the *objective* examination of the interior of the eye, we find, as almost a matter of course, that the optic nerve is hyperæmic. It cannot be asserted of all cases, and a practical difficulty arises, as to what degree of vascularity in the nerve is to be accounted abnormal. I have not indicated this condition except when the picture of the nerve was an emphatic one. It is noted among my cases thirty-eight times. It would have been spoken of much more

frequently if every case had been examined with the ophthalmoscope, and if note of what was seen had been made in every examination. In these instances there was a state of the nerve which would have been pounced upon by self-styled cerebroscopists (!) as evidence of head trouble. No caution needs to be more pointedly given, than against drawing unjustifiable inferences from the vascularity of the optic nerve. The hyperæmia of these cases exists not only in the capillaries, but also in the veins, and I can recall cases in which the arteries and veins were both distended and sinuous, twisting about in a remarkable way, yet by no means authorizing a diagnosis of either neuritis or retinitis, much less of cerebral congestion. Such persons usually possessed a complexion so florid as to be in perfect keeping with the state of that portion of the internal circulation which the ophthalmoscope permits us to observe. Unless there are signs of infiltration and swelling, and opacity in the nerve, the fact of hyperæmia counts for very little.

While on this point I will add some of the incidental observations made in this connection. Opaque optic nerve-fibres have been found, to greater or less degree, to be present in thirteen cases. Oftentimes there is concomitant redness of the nerve, and, if the quantity of opaque fibres is large, the redness will be by contrast more conspicuous, and sometimes is actually, as well as apparently, intense. How to distinguish between the congenital opacity of the nerve-fibres and the changes due to infiltration, it is not necessary for me to state.

Deposit of pigment, making a distinct dot upon the disk of the nerve, has been three times recorded—in one case there were several such dots. This appearance is wholly dissimilar from the common pigmentation of the edge of the disk, where the choroid lies in contact with it. I am sure that I have seen more instances than I have recorded.

In five cases there was a line or band of connective tissue running across the disk—sometimes of a glistening whiteness, sometimes semitransparent. It sometimes looked like an obliterated vessel, and in most cases this would be the probable explanation of almost all of them.

It is not needful to allude to the frequency and great variety of the plane of the nerve-surface. Physiological excavation assumes every degree of depth and position. It is quite as frequent to be confined

to the temporal side and sloping, as to be central and uniform. Again, it is sometimes extremely difficult to distinguish a physiological excavation from one caused by glaucoma. On the other hand, the nerve may rise above the plane of the fundus. A case of exceptional rarity is as follows: A Cuban gentleman, having O. D. $-\frac{1}{7}$ s. ⌒ $-\frac{1}{24}$ c. 10°, V. $=\frac{20}{10}$, O. S. $-\frac{1}{12}$ s. ⌒ $-\frac{1}{12}$ c. 75, V. $=\frac{20}{50}$, was found to have in each optic nerve a physiological excavation upon the *nasal* side of the disk, instead of on the temporal side, as customary. It extended to the middle of the nerve, where it was deepest and sloped upward to the inner edge. The inner half of the disk was thus characterized, and the outer half was congested and of normal plane. The depth of the excavation I did not estimate, but it was not extreme. There was no circum-optical choroidal atrophy. The vessels emerged from the nerve upon the sloping surface, and were clustered upon the horizontal meridian, and passed to their distribution over the fundus in the reverse of their normal direction. They made a large bend above and below, to pass to the macula lutea, and were tortuous and numerous. The aspect of the nerve suggested the look of a lily with the stamens lying upon one side.

One additional point requires mention, viz., that high degrees of hypermetropia always present a deeply congested optic nerve, and one in which there is frequently an ill-defined and striated border, and want of transparency in the tissue of the nerve. This fact is well recognized, but should not be omitted in connection with remarks upon congestion of the optic nerve.

12. The acuity of vision in asthenopia may be either perfect or imperfect. It is by no means to be taken for granted that V $=\frac{20}{20}$ excludes the presence of refractive error. It excludes errors of a high degree, but it permits the existence of errors which may be competent to cause the painful symptoms. It is generally accepted that $\frac{20}{20}$ is not a strenuous exaction upon sight; very many will give $\frac{20}{15}$, and with bright light $\frac{20}{12}$ is not uncommon. What I particularly wish to emphasize, and to which I shall return again, is, that compliance with the standard of visual acuity does not render a careful examination of refraction needless. Not only does this apply to ordinary hypermetropia, but equally to hypermetropic astigmatism and to other faults. Spasm or persistent tension of accommodation may conceal the optical defect, while with-

out assuming the existence of morbid tension for distant vision it may suffice to excite pain for the near point and coincide with V. $= \frac{20}{20}$.

It is almost superfluous to add that the cases of asthenopia with imperfect vision do not always admit of complete correction, nor does the residual defect always prevent the cure of the distressing symptoms.

13. A disposition to approximate the near point of vision is a frequent characteristic of asthenopia; of course, cases of M $> \frac{1}{10}$ are not alluded to in this remark, while many cases of astigmatism and hypermetropia are specially indicated. It is to be stated that this behavior obtains in cases of small as well as of large optical error. Oftentimes the reading or seeing is begun at the usual distance of twelve to sixteen inches and after a time the work is brought closer until pain compels the person to cease, and the trial is repeated after a rest, with a renewal of the same manœuvres; of course, in such cases, there is increasing effort of accommodation during all the act of near vision. Both muscular and refractive asthenopia present this behavior, but it is not an invariable symptom.

The next point for consideration is the *etiology* of asthenopia.

The older writers understood and dwelt upon the influence which impaired health exerts upon the working power of the eyes, and this must be recognized in some cases as the essential and only cause of the symptoms, but for the great majority of cases the ill-health is but the exciting and not the essential cause. It serves to render potent for evil, deficiencies which, in better physical conditions, would have been utterly harmless, or it aggravates their capacity for mischief. It therefore needs to be estimated at its due proportion in the problem which we are called to solve.

But the controlling cause lies in local disturbances; of these the larger part are refractive and muscular errors. I am obliged to state them in conjunction, because as a clinical experience they are oftentimes found combined. There are, however, cases of pure refraction and also cases of pure muscular trouble. The statistics will be given further on. An-

other but limited class of cases are those of paresis of accommodation, and the still fewer number of *intrinsic* spasm of accommodation, excluding other eye troubles.

Another class of cases are associated with symptoms of irritation at the cervical part of the spinal cord and base of the brain, the eye symptoms being the conspicuous features. I shall cite cases of this kind with a desire to call attention to their peculiar features, which I think have been unnoticed or undervalued.

Another subdivision must include patients who get asthenopic troubles as a sequence of nasal catarrh. It may be said that these cases should be classified and treated as chronic conjunctivitis. It were better to assign them to the category of nasal catarrh and treat them as such. But the fact remains that a certain number of patients are found incapable of using their eyes in whom no other lesion is found than nasal catarrh, and slight palpebral conjunctivitis. These cases will be subsequently specified more particularly.

On the general topic of etiology I wish to declare my strong conviction that, for the immense majority of cases of asthenopia, an adequate and intelligible cause can be found—one which can be scientifically appreciated, and which will not defy examination under the vagueness of general terms. In this persuasion I have rigidly examined my cases, and recorded what I found to be essential. I have corrected any errors which I could discover, without preconceptions as to whether certain degrees of error were necessary to excite symptoms, and have judged my notions of what was a competent cause by the actual results of experience.

I have found that the correction of *slight* defects becomes often of essential importance. I have also found that hyperopic astigmatism in small degrees is one of the most effective causes of trouble, and that mixed astigmatism occurs more frequently than I think is commonly held, and is furthermore eminently potent for evil.

Among cases of muscular trouble, I have been helped out of perplexity by finding small deficiencies in the externi, or in the movements of the globe in a vertical direction. The

discovery that the eyes could not be easily carried to and maintained at extreme positions, as at the outer angles, or when looking high upward, has suggested the source of difficulty. So, too, the fact that the cornea makes a slight rotatory movement when the eyes are carried along the horizontal plane, suggests want of equilibrium in the oblique muscles. In a few cases, all movements of the globes are found to be unsteady, or jerky, and the fact has essential importance. There need be nothing like nystagmus or diplopia, and there may or may not be refractive errors.

Besides the above varieties of asthenopia, another form, called hyperæsthesia of the retina, has been distinguished by most authors, and to it Graefe calls attention in the closing paragraph of his paper on muscular asthenopia (*Arch. f. Oph.*, Bd. viii., 2, 366). He admits that added to this condition is often a certain degree of accommodative and muscular disturbance, but declares that this condition acts an inferior part in the mischief, and offers no outlet for successful treatment. He assigns the primary lesion to undue sensibility of the retina, or to neuralgia of nerves of sensation.

I believe that, while a very few cases of this description may exist, their number is much smaller than has been often assumed. I also regard this kind of diagnosis as one which too often gives cover for imperfect examination — either through haste, or neglect, or incompetence of the oculist. It is one which can only be established by the rigid exclusion of every possible form of lesion such as I have detailed. Even then I am not sure but that we shall yet discover some hitherto unknown cause for this exalted irritability in a constitutional dyscrasia or some abuse of the eyes.

Besides the conditions above quoted, it is true that other diseased states render use of the eyes for near work difficult, and I quote the language of Donders:

"Congestive conditions, especially in myopic persons, beginning amblyopia, granular conjunctivitis, impair the capacity for near work; the phenomena arising from these lesions differ materially from those of asthenopia, and they should not be reckoned in the same category. Neuralgia of the eye is aggravated by using the organ, but has nothing in

common with asthenopia." That these remarks are just is as true as that it is also impossible to limit the use of the term asthenopia to cases of hypermetropia, as Donders in 1860, and in his book, 1864, attempted to do. We must permit some vagueness in the use of the word for the sake of convenience of language, and at the same time distinctly indicate the pathological condition which excites the functional troubles.

The following is a classified summary of the cases of refraction which form the bulk of the material discussed in this paper. I have taken them as they occurred in succession, and have brought them up to make 1,000. In all these persons both eyes have been examined, and, when there was between the two eyes no greater difference than $\frac{1}{48}$, the cases were tabulated together; when a greater difference existed the fact is observed in the classification. The following is the general statement:

Hypermetropia, o. u.	185	
Hyperopic astig., simple, o. u.	48	
" " comp., o. u.	69	302
Myopia, o. u.	223	
Myopic astig., simple, o. u.	36	
" " comp., o. u.	78	337
Mixed astigmatism	37	37
Myopia differing in the two eyes	44	
Myopic astig., simple, differing in the two eyes	12	
" " comp.	49	105
Hypermetropia differing in the two eyes	19	
Hyperopic astig., simple, differing in the two eyes	14	
" " comp., " " "	27	60
Myopic astig., simple, one eye } Myopia " " }	9	
Myopic astig., comp., one eye } Myopia " " }	42	
Myopic astig., comp., one eye } " " simple, " " }	10	61
Hyperopic astig., simple, one eye } Hypermetropia " " }	12	
Hyperopic astig., comp., one eye } Hypermetropia " " }	27	
Hypermetropic astig., comp., one eye } " " simple, " " }	11	50
	952	

ANTIMETROPIA:

Hypermetropia, one eye } Emmetropia, " " }	5
Hypermetropia, one eye } Myopia..... " " }	3
Myopia.....one eye } Emmetropia.... " " }	11
Myopic astig., comp., one eye } Emmetropia..... " " }	4
Myopia.....one eye } Hypermetropic astig., simple, " " }	1
Myopic astig., comp.....one eye } Hyperopic astig., simple..... " " }	13
Hypermetropic astig., simple, one eye } Emmetropia..... " " }	6
Hyperopic astig., comp.....one eye } Emmetropia..... " " }	3
Myopic astig., simple.....one eye } Emmetropia..... " " }	2—48
	1,000

The following condensed statements may be derived from the above:

Leaving out of view the forty-eight cases of *antimetropia*, as I think it right to designate those in which the refraction in the two eyes is of essentially different quality, as seen by the table, we have 952 cases.

Out of these, 481 exhibited astigmatism, leaving 471 in whom the refracting surfaces were of symmetrical curve. I think this proportion of astigmatism is larger than has hitherto been supposed to exist.

Leaving out of view this kind of error, it appears that there were 412 persons whose eyes had the hyperopic form, and 503 persons whose eyes had the myopic form.

The cases not counted in this enumeration are thirty-seven, of mixed astigmatism.

The cases of hypermetropia without astigmatism were 204. The cases of myopia without astigmatism were 267. There were thirty-nine cases of hypermetropia in one eye and hyperopic astigmatism in the other, and fifty-one cases of myopia in one eye and myopic astigmatism in the other. These ninety cases are left out of the estimate of H. and M. just given.

In the total of 1,000 cases there are 351 in whom the refraction of the two eyes differ by more than $\frac{1}{48}$. These were designated by Kaiser under the name of anisometropia. In forty-eight of them the refraction in the two eyes was of opposite or dissimilar qualities, and these I venture to designate as cases of antimetropia. It seems to me that a new word to designate these will be found convenient.

It is superfluous to dwell upon hypermetropia in its relations to asthenopia—that subject has been exhaustively handled by Donders.

As a small contribution to statistics, I may say that I find twenty-seven patients with H. in one or both eyes more than $\frac{1}{8}$. Of these, six had converging strabismus. The degree of vision in nine eyes was $\frac{20}{200}$, in twenty-six eyes V. $= \frac{20}{40}$ or better.

Three eyes were seen having H. $\frac{1}{3}$. Both patients had converging strabismus; in one the other eye had astigmatism corrected by $+ \frac{1}{12}$ c. 95°. One eye having H. $\frac{1}{3}$ had vision $\frac{20}{100}$. In the remaining two eyes the vision is not recorded. The amount of H. in these cases was determined by the ophthalmoscope. Mr. Bowman observed a patient with H. $\frac{1}{2}$, as is noted by Donders, page 290.

Neither do I attempt a discussion of myopia merely as a refractive error. As Donders has implied in remarks above quoted, the beginning of its development is often attended by pain and fatigue during near work. The relations of muscular insufficiency to myopia, and of tension of accommodation to myopia, will be afterward considered.

While the development of M. belongs to early life, I have noted *four* cases in which its commencement was deferred until after middle age.

Case VIII.—One, a highly educated gentleman, aged forty-four, professor of Hebrew in a theological school, had O. D. $- \frac{1}{24}$ s. V. $= \frac{20}{30} +$ and O. S. $- \frac{1}{36}$ s. V. $= \frac{20}{30} +$. In both eyes minute traces of opacity in the lens. His knowledge and observation made him certain that his vision for distance had been perfect until within a year or two. Moreover, while it was possible, with a magnifying lens, to detect the minute specks in the marginal part of the lens, none could be seen about the pupil.

It is not improbable that myopia may have ensued from change in convexity of the lens attending the primary evolution of cataract.

Case IX.—Mrs. Q., aged forty-nine, has O. D. $-\frac{1}{4\frac{1}{2}}$ s. $-\frac{1}{24}$ c. 15°, V. $=\frac{20}{40}$. O. S. $-\frac{1}{12}$ s. $-\frac{1}{18}$ c. 180°, V. $=\frac{20}{30}$ +.

In right eye there is a large patch of choroidal atrophy on the temporal side of the nerve, and a thread floating in the vitreous. In the left is less extensive choroidal atrophy at the lower edge of the nerve. She remembers that four years ago she could read large signs across the East River, a distance of half a mile, and two years ago could readily read signs in the street, and recognize faces of her friends as they went by, and even one year ago vision at a distance was much better than now. For the past year she has been ill with rheumatism, and had heart complication; had frequent fainting-fits. Her eyes have given much pain, and she has been much disturbed by the impairment of vision. Muscæ volitantes have annoyed her greatly. This case, which rests for its authenticity upon the correctness of the patient's perceptions, seems to be clearly one of elongation of the visual axis during mature life.

Case X.—Mrs. S. H., aged fifty-eight, Brooklyn, has O. D.— $\frac{1}{60}$ s. — $\frac{1}{60}$ c. 105°, V. $=\frac{20}{20}$. O. S. $-\frac{1}{48}$ s. $-\frac{1}{48}$ c. 10°, V. $=\frac{20}{20}$. Has had rheumatic gout within ten years, with dropsy, incontinence of urine, hæmorrhoids, and other sequelæ. Says she began to get near-sighted only within ten years. Is now presbyopic. Ophthalmoscopically, nothing is to be noted, except a minute yellow dot at macula lutea of left eye.

Case XI.—Rev. C. C. B., aged seventy, Ohio. Has cataract in each eye; in the right, so dense as to preclude deeper examination; in the left, I can see a large, circumoptical, choroidal atrophy, and floating bodies in the vitreous. The myopia of left is estimated as $-\frac{1}{6}$ s. $-\frac{1}{16}$ c. 35°, V. $=\frac{20}{200}$. Besides the posterior staphyloma, there is a patch of choroidal atrophy above the nerve, and another one below, and some distance from it, which is about four nerve-diameters in width. He has always been of studious habits, and states that, twenty years ago, he could see distinctly at a distance, and did not until then begin to wear concave glasses. Then he used them only occasionally, and not until the past ten years has he constantly relied on them. His health has always been feeble, and he has had frequent attacks of violent headache. Having gained some intimacy with this gentleman, I placed confidence in the correctness of his observations respecting his sight; and the subject was one to which his attention would be drawn with more directness, because his wife had become blind by cataract.

In two of these cases, there was evident choroidal disease, and there was sufficient reason for believing that such distention could take place in the globe as would entail myopia, just as staphyloma might occur upon any portion of the sclera. The others were uncomplicated.

Mauthner (p. 262) remarks upon a case of M., acquired in late life, that he has seen only a slight degree supervene at this age. That considerable degrees are possible, two of the above stated cases demonstrate.

I find, among two hundred and sixty-seven cases of myopia, forty-six which equal or exceed $-\frac{1}{4}$. Among them is found a considerable amount of intra-ocular lesion, and in all the degree of vision is below standard. When, however, proper allowance is made for the reduction in the retinal image, which is caused by strong concave glasses, the acuity of vision in some will be found about equal to the average.

For example: Miss S., a school-teacher, aged twenty-three, for the right eye uses $-\frac{1}{2}$ s., and for the left uses $-\frac{1}{2\frac{1}{4}}$ s., and has in each V.$=\frac{20}{30}$, which, being modified according to the tables which Mauthner gives at page 186, on the supposition that the glasses are worn $\frac{3}{4}''$ in front of the anterior nodal point, gives O. D., V. $=\frac{25}{30}$, and O. S., V. $=\frac{26}{30}$. For the most of them, no such happy condition exists.

Out of these cases, two deserve relation because of the extreme degree of M.

Case XII., 1874.—Master R. R. H., aged fifteen, Michigan; weight, ninety-eight pounds, of good development; is the fifth of seven children, of whom six are living; is the only one with defective sight. Parents have good eyes, and good development. At his sixth year, had frequent, sudden, and severe headaches; was otherwise well, and of late years had no illness.

The myopia was so extreme that I could not bring a concave lens of any power close enough to the eye to estimate it with the upright image. It can be done with a pretty close approximation by using the inverted image in a particular way, to which Liebreich first called attention. It is to use a convex glass of short focus behind a mirror, say +2, and observe the inverted image which is naturally formed in front of the eye. With a lens of this focus, very little range of accommodation is possible; but, by taking pains to withdraw from the patient

as far as distinct perception of the image will permit, the location of the image may be determined, by measuring the distance from the mirror to the patient's cornea, and subtracting from this distance the focal length of the lens, viz., 2″. An error of $\frac{1}{8}$ inch may occur, but a close approximation to the degree of M. is obtained. By this proceeding, and by trials with glasses, I found the refraction to be:

O. D. $-\frac{1}{1}$ s. ⌒ $-\frac{1}{6}$ c. 180°, V. $=\frac{20}{100}$.
O. S. $-\frac{1}{1\frac{5}{6}}$ s. ⌒ $-\frac{1}{4}$ c. 180°, V. $=\frac{20}{100}$.

In the right eye the lens was wholly transparent; seemed to be small; was dislocated upward to a slight degree, so that I could see its border when the pupil was dilated. I could not get an image of the fundus outside of the lens. It was not properly attached to the suspensory ligament, but shook with slight movements of the eye. There were no opacities in the vitreous. At the macula lutea was a spot of choroidal atrophy, and over a considerable extent of surface were evidences of choroidal lesion. It was marked with brownish spots and streaks, and seemed to be attenuated. The remarkable fact was noticed that around the optic disk there was no atrophy of the choroid whatever. In the left eye precisely the same facts existed, as to the dislocation of the lens, the central lesion of the choroid, and the absence of circumoptical atrophy. The optic nerves presented no features of notable importance. The examination was of necessity very difficult, and the boy was seen by Dr. Agnew and Dr. Knapp, who confirmed the above observations. The boy had learned to read, and habitually pressed the paper to his face, so as to blacken the tip of his nose. I gave him a pair of Steinheil's cones, each $-\frac{1}{4\frac{1}{2}}$ for reading. He was able to use them with considerable comfort.

Case XIII., 1867.—Dr. McK., aged seventy, Brooklyn. Had M. $-\frac{1}{1\frac{1}{4}}$, with central opacity on deep surface of the lens; a partial detachment of the retina below, and great circumoptical atrophy. The atrophic surface was very irregular, and ran out in the form of fingers into the adjacent region. No other details of the case are given.

Another exceptional feature in myopia may be adduced, viz., the occurrence of *strabismus convergens*. I find seven cases in which this occurred. In one it had spontaneously disappeared; for two I performed tenotomy. The convergence was not an apparent one, but an actual inward deviation with loss of binocular vision.

Case XIV.—In one case, Mr. C., aged twenty-two, O. D. $-\frac{1}{6}$ s.,

V. = $\frac{20}{20}$. O. S. — $\frac{1}{4\frac{1}{4}}$ s., V. = $\frac{20}{20}$. In neither eye was there any circumoptical atrophy or other lesion. He has used glasses for five years but never employs them in reading. Never has pain in his eyes; has studied closely, and has just graduated from college. The strabismus for the distance of 20 feet is measured by a prism of 40°. He can with its aid bring the two images of a candle into contact, but does not fuse them, and has no instinct for binocular vision. Has always used each eye at pleasure, and has the habit when reading of looking at the right page with the right eye, and at the left page with the left eye. So complete is the dissociation of the eyes that, when by prisms he is enabled to recognize the two images of a near object, although each is fully appreciated, and both seen at the same moment, however close to each other they come, he makes no effort to combine them. Patient did not desire to have an operation done, unless he could be assured that by it he would realize valuable benefit. I was not disposed to urge upon him its performance.

Case XV.—Another case, 1875, was Dr. Q., aged twenty-nine, New York. O. D. — $\frac{1}{5}$ s. ⌒ — $\frac{1}{48}$ c. 180°, V. = $\frac{20}{20}$. O. S. — $\frac{1}{5}$ s., V. = $\frac{20}{20}$. Had strabismus convergens since he was nine years old; it amounts now to $2\frac{1}{2}'''$. Says that, previous to his thirteenth year, his myopia was so slight that he could shoot with a gun fairly well. I divided both interni, and he gained binocular vision. He was much pleased with the improvement, both of personal appearance and of vision. He found that use of his eyes was more perfect than before the operation. I find no note of the state of the fundus oculi.

In another case, 1868, which has been quoted before, the degree of M. was $\frac{1}{2}$, there was complete and annular circumoptical choroidal atrophy, the eyes deep in the orbits, and the convergence noticeable.

It only need be said, in connection with the above cases, that it is fair to assume that there was an original weakness of the recti externi, and with the development of M. the necessities of vision brought about the complete overmastery of the externi by the interni, and with this process the accommodation had nothing to do.

I have seen in public practice other cases besides the above seven, and believe that observation would decidedly enlarge this category.

Next in order comes the subject of astigmatism, and to

this matter I have given close attention. The total number of cases is 481.

Hyperopic astigmatism, simple	74	
" " compound	123	
" " one eye simple, the other comp.	10	207
Myopic astigmatism, simple	57	
" " compound	169	
" " one eye simple, the other comp	11	237
Mixed astigmatism		37
Total		481

To find so large a proportion of cases of this error may be surprising, but I explain it by saying that I have always searched diligently for it, using not only usual tests of every kind, but studying carefully with the upright ophthalmoscopic image, and oftentimes using atropia in the examination. Moreover, I have no hesitation in correcting astigmatism $\frac{1}{48}$, and have frequently noted $\frac{1}{60}$ or $\frac{1}{96}$, and sometimes given the glasses to correct them.

The proportion between hyperopic astigmatism and myopic is almost an equal ratio, which is contrary to Donders's experience, who found compound myopic astigmatism uncommon, and the compound hyperopic form predominant. He also found simple hyperopic astigmatism the most common variety of all, and this statement is in accord with the above figures.

That many more cases of astigmatism should be discovered than attracted the attention of Donders is not surprising, when it is remembered that the methods of testing its existence have been greatly improved by the suggestions of Javal, of Pray, of Green, and of Thomson, of whom the last three are my fellow-countrymen.

In the preliminary steps of examination of asthenopic cases, I attach considerable value to the effect on the acuity of vision of weak convex glasses. For example, without glasses, there may be V. = $\frac{20}{30}$. Placing before the eye in succession + 48 s. and + 36 s. V. may remain at $\frac{20}{30}$ or decline to $\frac{20}{40}$; trying + 24 s. V. becomes $\frac{20}{70}$ or possibly $\frac{20}{100}$; that is, while to certain powers of spherical glasses acuity

remains nearly the same, an additional small quantity produces a sudden and extreme diminution of sight. I usually find that in these cases some form of astigmatism can be safely predicted, and may be discovered sometimes without resorting to atropia—it will almost certainly appear after resorting to it. I have most often found the hyperopic astigmatism, but other varieties may appear. I call attention to this point as affording a valuable hint in helping decide whether it may be needful to resort to atropia to ferret out obscure and slight degrees of ametropia.

In all the tests, the fundamental principle is that which Donders announced, but the art of making patients appreciate differences in diagrams consists, first, in rendering these differences at the same time simple and conspicuous; second, in asking questions in language fitted to their mode of thought and degree of comprehension; and third, in a readiness to understand what a patient's explanations really signify. Words are used by persons of varying culture in very different senses, and it is of the highest importance to be able to catch the meaning which the patient applies to his own words, and to employ to him such phrases as shall be intelligible to both. It is also needful for the examiner to have a perfect understanding of all the optical phenomena which astigmatism may produce, and be able to interpret them aright. The great amblyopia which often exists, and the inability of many patients to judge what is correct vision, impede them in explaining what they see, and oftentimes they contradict themselves in the most perplexing way. Hence the methods must be simple, and the sitting not so prolonged as to exhaust the patient's power of attention. In many cases of hyperopic astigmatism, and not seldom in other forms, there can be no decisive conclusion without paralyzing the accommodation. For cases in which decided amblyopia coëxists, the use of Scheiner's test, as suggested by Dr. Thomson, of Philadelphia, and of the tests to be used by transmitted light which Dr. Green, of St. Louis, constructed, and to which Dr. Strawbridge, of Philadelphia, afterward called attention, is of special value. The ophthalmoscope is of the highest service in these cases. The most valuable test for ordinary cases is

one of Dr. Green's, composed of radii which meet in a point at the centre of the card, and have a breadth of about one-half an inch at its periphery.

There are thirty black and thirty white radii upon the card. By drawing upon the opposite side of the card two black lines of the same kind running all across it, making four radii, a figure is produced which I have come to consider the main dependence in working out astigmatism. It meets the cases of small and of large degrees of error. For the latter the outer portion of the lines suffices, and for the former the more central part is suitably exacting. With these lines it is needful to use only spherical glasses. One must first find what is the meridian of greatest refraction in the hyperopic and of least refraction in the myopic eye, and place the lines in this direction at the distance of twenty feet. Then modify the glass, if any is needed, until the lines and the space between them are seen with perfect clearness to the centre. Then turn the lines through 90°, and add to what has been previously found the positive or negative glass which will make them again perfect. Of course, the difference in these meridians is the astigmatism, and, this being represented by the proper cylinder, a combination is now found for looking at test-types.

I find this proceeding, which I have not given in full detail, but in hints, adequate to almost all cases. It has superseded the apparatus of Javal, which I employed for many months, and is vastly superior to the stenopaic slit held before the patient. It, in reality, is in optical effect identical with the slit, and furnishes an object more distinctly seen and better illuminated. It is both simple, adequate, and impressive.

A large contingent of those who complain of asthenopia are astigmatic. Those most liable to suffer are, first, the cases of simple hyperopic astigmatism, especially in whom the meridian of least refraction approaches the horizontal; second, cases of hyperopic astigmatism, either simple or compound, in whom the principal meridians are oblique in diverging or converging directions; and third, cases of mixed astigmatism.

I present the following case of simple hyperopic astigmatism:

Case XVI.—Mr. A. M. D., aged thirty-five, merchant, seen in October, 1874; lost his left eye by a shot from a fowling-piece eight years ago. The globe is a little atrophied and soft, the iris drawn into the wound—is not tender on pressure. Has severe palpebral conjunctivitis in both eyes; has headache and intermittent neuralgia; did not complain seriously of the other eye, the right, until four months ago; has muscæ before it, indistinctness of distant vision, and pain in using it. These symptoms have been attributed to sympathetic irritation originating in the lost eye. Soon after it was lost, an eminent oculist advised its removal, and, being again consulted for the later troubles, repeated the advice, giving the opinion that sympathetic inflammation had already begun, as ophthalmoscopic examination disclosed to him. I found by the ophthalmoscope that the optic nerve was deeply red, all the vessels turgid, its edges well defined, a small central excavation, no infiltration of the retina. I also perceived that there was a high degree of hyperopic astigmatism. On making the examination by trial-glasses it was found that $+\frac{1}{7}$ c. 95° gave V. $=\frac{20}{30}+$. I ordered this glass, and decided against extirpating the other eye, although I stated that the time might come when this operation would be imperative. The patient was excessively reluctant to submit to it. In February, 1876, I made the note that vision was easily $\frac{20}{20}$ with above glass, that the conjunctival irritation persisted, and in other respects the patient was in a most satisfactory condition. Could see better than he ever could before, and used his eye without fatigue. In September, 1876, I saw him again, and he was doing well.

A case similar to the above happened to me in 1870:

Case XVII.—A girl, aged thirteen, lost the right eye by a blow of a stick, and it afterward gave so much trouble that I extirpated it. Two months after the remaining eye became very irritable, it had phosphenes, and V. $=\frac{20}{200}-$. With great trouble and by the help of atropia I found the ametropia as follows: $+\frac{1}{24}$ s. $+\frac{1}{16}$ c. 60°, V. $=\frac{20}{50}-$. The use of these glasses put an end to the complaints of the patient.

Perhaps the number of cases of mixed astigmatism will excite surprise, because of the ratio which they bear to the total number reported. They constitute thirty-seven of all

the cases of ametropia, and about nine per cent. of the cases of astigmatism.

MIXED ASTIGMATISM:

O. D. — 36s ..... — 48c 110° ..... V. = 20/20.
O. S. + 48s ..... — 9c 90° ..... V. = 20/20.

O. D. + 36s ..... — 9c 12° ..... V. = 20/30.
O. S. + 36s ..... — 9c 180° ..... V. = 20/30.

O. D. .. .. + 48c 180° ..... V. = 20/30.
O. S. — 36s ..... + 12c 80° ..... V. = 20/30.

O. D. + 12s ..... — 6c 175° ..... V. = 20/40.
O. S. + 12s ..... — 6c 180° ..... V. = 20/40.

O. D. — 16s ..... — 24c 180° ..... V. = 20/40.
O. S. + 48s ..... — 20c 170° ..... V. = 20/40.

O. D. + 24s ..... — 7c 170° ..... V. = 20/70.
O. S. .. E .... V. = 20/20.

O. D. — 9s ..... — 16c 170° ..... V. = 20/100.
O. S. — 30s ..... + 8c 107° ..... V. = 20/50.

O. D. .. .. — 16c 110° ..... V. = 20/20.
O. S. + 48s ..... — 12c 70° ..... V. = 20/20.

O. D. + 24s ..... — 10c 20° ..... V. = 20/40.
O. S. .. E .... V. = 20/20.

O. D. + 24s ..... — 10c 10° ..... V. = 20/30.
O. S. .. E ....

O. D. + 36s ..... — 12c 140° ..... V. = 20/50.
O. S. + 36s ..... + 12c 105° ..... V. = 20/50.

O. D. .. .. — 48c 120° ..... V. = 20/20.
O. S. + 36s ..... — 16c 75° ..... V. = 20/20.

O. D. + 24s ..... — 9c 20° ..... V. = 20/20.
O. S. — 12s ..... — 9c 45° ..... V. = 20/50.

O. D. + 36s ..... — 18c 150° ..... V. = 20/20.
O. S. + 42s ..... — 16c 165° ..... V. = 20/20.

O. D. + 36s ..... — 8½c 90° ..... V. = ...
O. S. .. .. — 11c 90° ..... V. = ...

O. D. + 36s ..... — 18c 180° ..... V. = 20/20.
O. S. + 36s ..... — 18c 180° ..... V. = 20/20.

O. D. — 10s ..... + 6c 180° ..... V. = 20/50.
O. S. .. .. + 60c 45° ..... V. = 20/30.

O. D. .. .. + 30c 82° ..... V. = 20/50.
O. S. — 48s ..... + 18c 90° ..... V. = 20/30.

O. D. .. .. + 48c 55° ..... V. = 20/20.
O. S. + 96s ..... — 36c 33° ..... V. = 20/20.

O. D. .. .. + 42c 90° ..... V. = 20/20.
O. S. + 30s ..... — 16c 160° ..... V. = 20/20.

O. D. + 36s ..... — 12c 10° ..... V. = 20/30.
O. S. + 24s ..... — 16c 180° ..... V. = 20/30.

O. D. + 20s .... V. = 20/30.
O. S. + 16s ..... — 9c 180° ..... V. = 20/50.

MIXED ASTIGMATISM:

O. D. + 48s ..... — 18c 180° ..... V. = $\frac{20}{25}$.
O. S. .. .. — 20c 5° ..... V. = $\frac{20}{20}$.

O. D. + 24s ..... — 10c 5° ..... V. = $\frac{20}{30}$.
O. S. + 24s ..... — 9c 180° ..... V. = $\frac{20}{30}$.

O. D. — 48s ..... + 20c 180° ..... V. = $\frac{20}{20}$.
O. S. + 36s ..... — 12c 90° ..... V. = $\frac{20}{20}$.

O. D. — 24s ..... — 16c 165° ..... V. = $\frac{20}{50}$.
O. S. + 48s ..... — 15c 7° ..... V. = $\frac{20}{50}$.

O. D. + 20s ..... — 8c 75° ..... V. = $\frac{20}{20}$.
O. S. — 12s ..... — 8c 110° ..... V. = $\frac{20}{40}$.

O. D. + 36s ..... — 11c 145° ..... V. = $\frac{20}{40}$.
O. S. — 48s ..... — 12c 25° ..... V. = $\frac{20}{50}$.

O. D. + 60s ..... — 20c 180° ..... V. = $\frac{20}{25}$.
O. S. + 60s ..... — 18c 15° ..... V. = $\frac{20}{25}$.

O. D. + 24s ..... — 7c 10° ..... V. = $\frac{20}{40}$.
O. S. .. .. — 36c 180° ..... V. = $\frac{20}{40}$.

O. D. + 24s ..... — 12c 15° ..... V. = $\frac{20}{50}$.
O. S. + 48s ..... — 12c 15° ..... V. = $\frac{20}{70}$.

O. D. — 48s ..... + 12c 75° ..... V. = $\frac{20}{30}$.
O. S. .. .. + 12c 100° ..... V. = $\frac{20}{30}$.

O. D. + 24s ..... — 12c 180° ..... V. = $\frac{20}{50}$.
O. S. + 24s ..... — 12c 180° ..... V. = $\frac{20}{50}$.

While there are thirty-seven patients there are but forty-three eyes affected. I have reduced the formulæ to an expression by which one surface of the glass shall have a spherical curve and the opposite a cylindric curve. This renders errors of grinding less likely to occur, inasmuch as only one cylindric axis must be considered. For example, with myopic astigmatism $\frac{1}{36}$ in the vertical meridian, and hyperopic astigmatism $+\frac{1}{36}$ in the opposite meridian, the same correction is obtained by the formula $+\frac{1}{36}$ s. $\supset -\frac{1}{18}$ c. 180° as by the formula $+\frac{1}{36}$ c. 90° $\sqcap -\frac{1}{36}$ c. 180°. It will be noticed that in all cases the spherical and cylindric surfaces must have opposite signs and the cylindric surface be in excess. A negative cylinder preponderates in a large proportion of eyes, viz., in thirty-seven, while a positive cylinder preponderates in six eyes, being in the ratio of six to one. Moreover, out of thirty-three patients only ten have mixed astigmatism in both eyes, and twenty-three have only one eye affected. The cylinder given represents the total astigmatism found by adding the two meridians together, and the extremes are from

$\frac{1}{36}$ c. to $\frac{1}{6}$ c. The spherical surface is in thirty-seven eyes less than or equal to $\frac{1}{24}$, and only in six eyes does it exceed $\frac{1}{24}$, rising in two eyes to $\frac{1}{12}$ and in one to $\frac{1}{10}$. It would, therefore, at first sight, appear as if the discrepancy between the two principal meridians which constitute mixed astigmatism was not in the great number of cases so great as to command correction.

For many cases where the spherical surface is $\frac{1}{48}$ or less, I admit that the error might safely be disregarded; but if it reach $\frac{1}{36}$, I decidedly assert the necessity for its being attended to. To omit it is to leave the cylinder either too weak by at least the amount of error left out of account, or, what is more likely, some other mistake is incurred which will be a source of trouble. My convictions on this point have grown out of actual experiences. Some instances have occurred where patients who had once received cylindric glasses, which, at the time, gave relief, have come for further advice, and I have discovered that the defect was in the non-recognition of mixed astigmatism. The failure to make the discovery in the first instance has sometimes been my own, and sometimes has been a slip of other practitioners; moreover, I have of late years found mixed astigmatism oftener than formerly, because I have been more impressed with its importance, and also been better able to detect it. Among my earliest cases of astigmatism, one of the mixed variety fell to me, and gave both the patient and myself a vast amount of worry before the error was elucidated. She happened to have the symmetrical error of $+ \frac{1}{36}$ c. with $- \frac{1}{36}$ c. in opposite meridians of each eye. How much the symptoms then puzzled me I shall not forget. This symmetry appears in other instances as O. D. $+ \frac{1}{12}$ s. $\supset - \frac{1}{6}$ c. 175°, S. $= \frac{20}{40}$, O. S. $+ \frac{1}{12}$ s. $\supset - \frac{1}{6}$ c. 180°, S. $= \frac{20}{40}$, and O. D. $+ \frac{1}{24}$ s. $- \frac{1}{12}$ c. 180°, S. $= \frac{20}{50}$, O. S. $+ \frac{1}{24}$ s. $\supset - \frac{1}{12}$ c. 180°, S. $= \frac{20}{50}$.

Case XVIII.—One case has a remarkable combination in the glass given for reading; the correction for distance is, O. D. $+ \frac{1}{24}$ s. $\supset - \frac{1}{9}$ c. 30°, V. $= \frac{20}{20}$. O. S. $- \frac{1}{12}$ s. $\supset - \frac{1}{9}$ c. 45°, V. $= \frac{20}{50}$. The person was about fifty-five years of age; the eye with mixed astigmatism obtained the more perfect acuity of vision; by adding for reading $+ \frac{1}{14}$ s. to the right, and $+ \frac{1}{12}$ s. to the left, the formula for a reading-glass was obtained—O. D. $+ \frac{1}{9}$ c. 120°. O. S. $- \frac{1}{9}$ c. 45°.

Case XIX.—For another case, with the formula O. D. $-\frac{1}{48}$ s. ⌒ $+\frac{1}{20}$ c. 180°, V. $=\frac{20}{20}$, O. S. $+\frac{1}{36}$ s. ⌒ $-\frac{1}{12}$ c. 90°, V. $=\frac{20}{20}$, the following facts are noteworthy: He was forty-six years of age; had for many years had asthenopic trouble, and could find no glasses to aid him; with the naked eye had O. D., V. $=\frac{20}{70}$, O. S., V. $=\frac{20}{200}$. When he wanted to see sharply, he had the habit of pulling the lids of the left eye out at the outer angle, and pressing with another finger upon the eyeball at the inner side. He thus made a stenopaic slit, and the pressure served to correct, in some measure, the astigmatism. The correction by glasses was to him a source of exquisite happiness.

I dwell on the matter of mixed astigmatism because of my conviction that not a few of the unrelieved cases of asthenopia are in this category. It is, I think, a general impression that such cases are rare, whereas I find them in the ratio of 3.7 per cent. of my whole number of cases of ametropia. Again, the neglected meridian does not, in the larger number, exhibit a high degree of error, and it is therefore accounted of little value. It asserts its importance, in a considerable number of cases, by entailing symptoms of asthenopia in spite of optical formulæ, which omit this ingredient. I beg to call attention to this matter, and ask for more searching scrutiny for this error. I aver that mixed astigmatism is a form of ametropia which demands the most exact optical correction, and especially is this true if it be associated with asthenopic symptoms. The use of atropine will usually be needful, and adoption of the simple test which I indicated above as the most available, or of Thomson's adaptation of Scheiner's test, will easily discover its presence and amount.

A point cognate to the above is the importance, in cases of asthenopia, of looking for and correcting slight degrees of ametropia.

I have selected from my list fifty-five cases in which there were refractive errors of various kinds, which would by many be regarded as insignificant, but which cannot be safely so regarded where symptoms of asthenopia exist. I do not argue that, in the order of sequence, the eye defect takes the lead in bringing about asthenopia. I find, on the contrary, that commonly something has impaired the power of endurance. It

has been overwork of the eyes, or trying them by night, or by dim light, or using them in railway-cars; there has been ill health, especially uterine disease, or nervous excitement from business anxieties, or great grief and weeping, or a sedentary life with sedulous study.

The combinations and varieties of condition which present themselves are almost endless. Under these circumstances, it is needful to search out even the small errors of sight, and apply the correction; at the same time, the accompanying conditions which have damaged the health, and the abuses which have been practised upon the eyes, must be rectified.

Case XX.—A bookkeeper, twenty-five years old, has for eighteen months had great pain in eyes and head when doing his work; even, in fixing eyes on a distant object, soon has pain, as when looking at the preacher in church; is sensitive to light; has palpebral conjunctivitis; has weakness of recti externi; optic nerves have a sharp central physiological excavation, which slopes toward temporal side. Find without atropia O. D. — 48 c. 180°, V. = $\frac{20}{20}$. O. S. — 48 c. 180°, V. = $\frac{20}{20}$. Is told to wear these glasses all the time. After a month, reports that the glasses are just the thing he needs; headache gone; sees at a distance with comfort, and sharply; does his work in writing easily. Directed to take quinine and iron, and instructed on points of hygiene.

Case XXI.—A theological student, aged twenty-three years, living in South Carolina, of great talent and industry, has worked hard, and for many months suffered so much pain and weariness of eyes that he feared he would have to abandon study. Health was not robust, yet he was not much run down apart from the worry which his eyes had caused him. Making use of atropine, I found and prescribed the following formula: O. D. + 36 s. — 48 c. 175°, V. = $\frac{20}{20}$. O. S. + 42 c. 90°, V. = $\frac{20}{20}$. He continued study, and found entire relief from his trouble, and sent me a warm message of thanks.

Case XXII.—Dr. W., aged thirty, is greatly annoyed by palpebral conjunctivitis; cannot read at night; is so much irritated by his left lids that he has a trick of pulling down the lower with his finger innumerable times during the day; he does it unconsciously, and has brought on himself the ridicule of his family by the trick. His desire to read is in such conflict with the irritability of his eyes that he can accomplish very little. Has tried various remedies for the palpebral congestion, to no good purpose. Resorting to atropine, I find O. D.

E., V. = $\frac{2}{20}$. O. S. — 60 s. + 36 c. 110°, V. = $\frac{2}{30}$ +. He uses these glasses, is enabled to read with them, and reluctantly consents to wear them continually (the right eye having a plain glass), and finds the congestion of the lids much abated, and that he can keep his fingers from pulling at the lower lid. His case is substantially cured, and is, in reality, one of asthenopia.

I could add many cases to the above, but it were weariness to do so.

I do not say that correction of small errors is always attended by happy results. Another element is to be remembered in asthenopia, viz., the abated endurance of the muscles of accommodation and fixation. This is in direct relation to the general health. Under these conditions there must be a concession as to the amount of eye-work which can be performed. Repose is needful, as well as invigoration of health. To some patients a limit must be assigned, beyond which they cannot expect to use their eyes. Sometimes entire discontinuance of work may for a time be required, but I very rarely give advice to this effect, because I seldom find it needful, and consider the moral effect of enforced idleness extremely unfortunate.

For these cases, the suggestions made by Dr. Dyer eleven years ago, to cultivate the power of accommodation by using a weak convex glass, or weak prisms, and put in practice a regulated and gradually progressive task of reading or sewing, have been adopted by all oculists, at least on this side of the Atlantic, with great advantage.[1] That patients can thus be brought, by additions of two to five minutes, to rise from a reading period of ten minutes to one of two hours twice daily, is matter of general experience. It may take one month or six months to do it, but very many asthenopics have thus been cured.

My point is that, for precisely this class of cases, the investigation of small errors is vital, and, when corrected, the glasses thus ascertained will be the proper ones to employ, according to Dr. Dyer's method, or may even obviate all the symptoms without the training.

[1] *See* "Transactions of the American Ophthalmological Society," pp. 2–28, 1865.

It is proper to add that, if the patients, by judicious management or some happy change of fortune, gain vigorous health, it is a very common thing for them to cease using their glasses, and not suffer any inconvenience thereby. It is, in most instances, a hardship for young persons, and especially young ladies, to wear glasses, and they gladly escape from them if possible. Many times my patients have told me that they no longer use their glasses, and their eyes behave sufficiently well. That they may properly do this is not more surprising than that a lame man, when well, should put away his crutches. In most cases, it is true, the error remains in the eye, but it ceases to be mischievous, because the conditions which produce exalted sensibility are no longer present. Not only does the state of health enter into this problem, but the period of life is influential. Very rarely do such cases appear in persons below twenty years of age; much oftener they are above twenty-five and thirty. The obvious reason is that an abated normal range of accommodation is a factor in the degree of sensibility.

My convictions are strong that the obstacles to success in treating asthenopia lie in the want of exact determination of the optical conditions, and in failure to use this information in connection with the well-recognized methods of general therapeutics.

It was a favorite practice, formerly, to send young men, whose eyes had given out in study, upon a sea-voyage, and often they recovered. On the other hand, I have been witness to their non-recovery. The reason for the success and for the non-success is made clear—at least, to my own mind—by the above statements. The relative value of the optical or muscular errors, and the errors in general health, determines the success of the proceeding.

I pass to the subject of *muscular asthenopia*. The musculi recti interni are so frequently the pair at fault, that the occurrence of weakness in other muscles is liable to be overlooked. Next in order of frequency come cases in which all the muscles are deficient, next, cases of weakness of the recti externi, and lastly, cases in which the movements of the eyes in the up and down direction are irregular. From the above

cases I exclude all which would be called nystagmus, although in many an unsteady action of the globes appears, when the eyes turn far in the line upon which the ineffective muscles move.

Among two hundred and twenty-seven cases of deficient muscles, I find the ratio as follows:

Mus. recti interni	172
" omnes	24
" recti externi	16
" obliqui vel. rect. sup. et inf.	15
	227

Of these patients the refraction was emmetropic in seventy-nine. From these figures it appears that impairment of the interni constitutes about three-fourths of the cases. The other fourth are entitled to proper recognition, which, it seems to me, they have failed to receive. Analyzing the cases of inefficient recti interni, I find that, while the refractive error myopia has a conspicuous place, it does not assume the first place, much less that predominating position which has been thought belongs to it. The one hundred and seventy-two cases are subdivided as follows:

Insufficiency of recti interni with E	60
" " " " " H	30
" " " " " M	56
" " " " " Astig	26
	172

Further, it appears that in E. insufficiency is less in amount than occurs in M. or in ametropia, but that it actually appears more frequently is not surprising when it is remembered how greatly emmetropic exceed myopic eyes in number.

Before discussing this matter, I must premise that, while the test suggested by Graefe of looking at a dot on a fine line with a prism, having its base vertical before one eye, has been in all cases resorted to, this test has not been exclusively relied on, nor has it been too highly esteemed.[1] It has

[1] I do not have any line running through the dot, but use a small white dot upon a black card. My examinations for the action of the muscles at

for most cases only formed a part of a rigorous examination of the muscular functions. Of late I have taken the power of adduction and abduction at twenty feet rather than for the near, and placed more reliance on the test for this distance, as showing what the extrinsic muscles could do, apart from the accommodation. I recognize that to many patients the process of testing is an experiment which they fail to perform well, because of its novelty, but this source of error has been eliminated by repeated trials and by taking all pains to give instruction. My earlier records are not all complete, and on them I place less reliance, but the facts so far as they are recorded can be accepted as carefully ascertained.

Among the emmetropic, a noteworthy fact appears, that for the larger number the total muscular power is weak, in other words, not only are the interni out of proportion, but they are absolutely below the average standard. An enfeebled state of muscles is the dominant fact, and that this should appear with emphasis, in efforts at near work, is the necessary result. In truth, a considerable portion of these patients are persons in poor health or wanting in general vigor. It is often remarkable how the condition of the eye muscles rises and falls with the tone of the general health. In one lady, who was for several years under observation, the asthenopic symptoms were by proper measures much relieved. She became pregnant, and, while in that state being always remarkably robust, her eyes became quite well—then, while nursing her infant, they fell off again to a condition worse than ever. Out of twenty-four cases in which the adductive power for twenty feet is given, there are eighteen in which it amounts to 14° or less, in two cases it goes as low as 6°. The following cases are cited as illustrating what the muscular conditions are:

Case XXIII.—E., add. at 20′ = 10°
abd. at 20′ = 8°
v. d. at 14″ = 16° divergence.

near distances are greatly facilitated by a simple contrivance of a wooden frame to hold prisms and a stem upon which the test-cards slide, the whole looking something like a stereoscope.

Case XXIV.—E., add. at 20′ = 6°
abd. = 6°
v. d. at 14″ = 16° divergence.
Case XXV.—E., add. at 20′ = 12°
abd. = 8°
v. d. at 14″ = 18° divergence.
Case XXVI.—E., add. at 20′ = 9°
abd. = 5°
v. d. at 14″ = 7° divergence.

In estimating the importance of these figures, we are met by the difficulty that we have not had a careful investigation of what should be the normal power of the ocular muscles. Of course, this differs widely in different persons, but some average could be made out. Another void in our knowledge is what amount of muscular power goes with varying degrees of accommodation. In other words, what degree of divergence and convergence should be possible for degrees of A. distant $\frac{1}{24}$ from each other, as Donders has established in discussing the relative accommodation. Not knowing what to rely on as the normal state, I have preferred to take the muscular capacity for a point so distant as to exclude accommodation. It has been my observation that very few persons can get along comfortably with less than 20° adduction for twenty feet distance, and 4° to 6° abduction.

Another point which has come up, is that spasm of accommodation may be excited in emmetropia by deficient muscles, as well as in ametropia. An illustration is:

Case XXVIII.—A medical student, aged twenty-three, with E. and V. = $\frac{20}{15}$, suffering from asthenopia. Has add. at 20′ = 13°, abd. at 20′ = 5°, v. d. at 14″ = 5° div. With + 12 reads Su. $1\frac{1}{2}$ from 8″ to $3\frac{1}{2}$″. Because he had a great deal of pain it was thought well to use sulph. atropia, by which the pain was annulled, and, while the spasm yielded, the divergence upon Graefe's test for the near disappeared. Here was an instance of the interaction between convergence and accommodation. His muscles being weak, they forced the accommodation to excessive exertion, and themselves, when A. was rendered needless by vertical diplopia, passed over in their weariness into divergence instead of the convergence suitable for 14″.

I shall recur to this matter again when discussing muscu-

lar insufficiency in myopia. I may remark that the cases now under consideration have been little regarded in general, because the share which the muscles contribute to the discomfort of myopics, has absorbed the ophthalmic attention.

I find thirty cases of hypermetropia with insufficiency of recti interni. None of them have H. greater than $\frac{1}{6}$, and most of them are below $\frac{1}{2\frac{1}{4}}$. As a rule, patients with H. suffer from accommodative asthenopia alone, but the combination with muscular asthenopia is not impossible. The addition to the eye of the needful glass, at once, of course, changes the muscular equilibrium, and usually develops a higher degree of insufficiency than without the glass. But it is not safe to rely upon the results of one examination, because, when the accommodative asthenopia is relieved by the convex glass, the muscular inaptitude may disappear. This remark belongs as much to the head of treatment as to symptoms, and the matter will be again mentioned. That the interni should with H. be incompetent is of course exceptional, this disability being much more likely to fall on the externi and result in strabismus, but the contrary condition certainly sometimes obtains.

Insufficiency of recti interni in myopia received at the hands of Graefe such elaborate consideration that little remains to be said. In explanation of his views of treatment Donders has shown how the fault lies in the lack of stimulus to exertion of the accommodation, because the near point comes so closely to the eye, and the extrinsic and intrinsic muscles of the globe do not establish coöperative relations. This is, of course, most striking in the higher degrees of M., i. e., more than $\frac{1}{6}$. But how the same fact sometimes comes forth in slight degrees of M. is illustrated as follows:

Case XXIX.—A bookkeeper, M. $-\frac{1}{2\frac{1}{4}}$, V. $=\frac{20}{20}$, add. at $20' = 16°$, abd. at $20' = 10°$, v. d. at $14'' = 18°$ div. Has worked steadily at his desk, is a great smoker, suffers severe pain in his eyes. That the distress was muscular was proved by the fact that wearing prisms, 3° base inward before each eye, obtained in three days entire relief from pain, and he could use his eyes for three hours easily. After five months' use of prisms and abandonment of tobacco, his headache and giddiness disappeared, his health improved, his eyes could work all day without

prismatic glasses, and their aid was only needful at night. Nevertheless, the muscular pain was no greater than before, and the insufficiency at 14″ had slightly increased. His acuity of vision had increased, and he was furnished with concave glasses — 24 s., while the prisms were laid aside. He had, by relieving his overworked interni, gained control of his accommodation. Another case is XXX., a law student, aged twenty-one, with M. $\frac{1}{18}$, V. $= \frac{20}{20}$, with — 18 s. at 20′ add. = 6°, abd. = 7° at 14″, add. = 9° at 14″, abd. = 14°, v. d. at 14″ = 6° divergence. The use of — 36 s., which stimulated the A., was enough to relieve the symptoms. In another case (XXXI.), a young lady, aged twenty-one, with M. $\frac{1}{16}$, V. $= \frac{20}{20}$, the insufficiency with v. d. for 14″ was 15°. Prisms each 4° with bases inward proved satisfactory for reading, but she could not use — 20 s. for distant vision, probably because abductive prisms should have been combined with it. She was wholly unused to the employment of accommodation for any distance, and the use of prisms simply rendered it possible for her to continue the unnatural mode of using her eyes without pain. Another case (XXXII.), in which the same method was employed, but carried still further, is Mrs. S., with O. D. — 24 s., V. $= \frac{20}{20}$ +, O. S. — 48 s., V. $= \frac{20}{20}$, + at 20′ add. = 16°, abd. = 7°, v. d. at 14″ = 8°. She was in delicate health, and had had pain in her eyes for two years. I gave + 36 s., with prisms 4° each eye, bases inward. Their effect was to remove from the eyes almost all necessity for either accommodation or convergence. After three years she came to report the complete success of the expedient, and that with the glasses she continued to work with entire comfort.

Another class of cases consist of persons in whom the weak interni provoke excessive action of the ciliary muscle or spasm of accommodation, a result which I believe to be extremely common in M. Mauthner gives a paragraph to this point (" Vorlesungen," S. 490, 491), in which he explains the discrepancy often found between the glasses which myopics choose for distance and their actual near point by supposing that the strong externi excite spasm of A. in distant vision. Perhaps this statement should be doubtfully received, because other considerations come in to modify the choice of the myopic in selecting distance glasses.

What I mean is illustrated as follows:

Case XXIX.—Miss C., aged seventeen, a diligent student, has M. $\frac{1}{48}$, V. $= \frac{20}{20}$; at 20′, add. = 20°, abd. = 8°, v. d. 14″ = 12° diver-

gence. She reads with a book at 10″, and cannot hold it at a greater distance without discomfort. Her health is good, but she has much headache—face is flushed. Prisms 2° before each eye, bases inward, enable her to read at 16″, and put an end to the pain of her eyes. During two months she used the prisms, and with good effect. I afterward laid them aside, and gave iron and strychnia. As she soon left school the severe use of her eyes became unnecessary. I have no doubt that the incompetency of the interni was responsible for the myopia as well as for the spasm of accommodation.

Case XXX.—Mr. K., aged seventeen, with M. $\frac{1}{36}$, V. $= \frac{20}{20}$. Is at school, and has acquired the habit of holding his book at 8″ from his face. At 8″ add. $= 27°$, abd. $= 25°$, v. d. at 8″ $= 6°$ divergence; abduction at 20′ $= 10°$; the adduction at 20′ not given. Has pain in eyes and severe palpebral conjunctivitis. Gave prisms 3°, bases inward, for each eye, to be constantly worn. After three weeks, he reported that eyes were as painful as before, but he could read now at 12″, and the myopia had disappeared; he now had with the plane prisms V. $= \frac{20}{20}$, without any concave glasses. He subsequently got entirely well, and did not become myopic.

In this case the use of atropia would have been a more expeditious mode of relief, but the efficacy of prisms is instructive. The beneficial effect of prisms in M. is in my judgment in part to be ascribed to their indirect influence upon the accommodation which is relieved from abnormal stimulation.

I have separated another class of cases of insufficiency of the recti interni, which were complicated with astigmatism—of these there are twenty-one. Most of them, namely twelve, are cases of simple astigmatism, and those which are compound exhibit a high degree of cylindric error in proportion to the spherical. Rather curiously, simple hyperopic astigmatism is twice as frequent as simple myopic astigmatism among these cases. In almost all these hyperopic cases the degree of insufficiency for the near is high; with one exception, it exceeds 10° and ranges to 20°. In all the cases of simple astigmatism the symptoms combine both accommodative and muscular asthenopia. In the cases where there is great diversity in the refraction of the two eyes, it is natural to look for muscular disturbance, and this in two of the five

cases of anisometry amounts to divergence more or less noticeable. The amount of cylindric error is usually small—the only exception being one of O. D. + 7 c., O. S. + 9 c., leaving out the cases of compound astigmatism. The well-known disposition of astigmatic persons to bring objects near makes it natural to expect that some of them should suffer from insufficiency of the recti interni, and the number of those who suffer must bear almost as high a proportion to the whole of this class as do muscular asthenopics to the whole number of myopics. The number of cases which I have collected demonstrates the necessity of making complete examination of all the ocular functions, even after a cause of trouble has been discovered, which might be plausibly considered a sufficient explanation of the symptoms. To show the effect of the refractive error upon the muscles, I quote the following cases:

Case XXXI.—Man, aged thirty-five. Has in each eye + $\frac{1}{36}$ c. 180°, V. = $\frac{20}{20}$; v. d. 14″ without glasses = 5° convergence; v. d. 14″ with + $\frac{1}{36}$ c. 180° = 3° divergence. This, of course, shows how the recti interni had been kept on the strain by the laboring accommodation.

Case XXXII.—Man, aged sixty, has O. D. + $\frac{1}{16}$ c. 5°, V. = $\frac{20}{40}$, O. S. + $\frac{1}{48}$ c. 5°, V. = $\frac{20}{30}$ +. With these glasses v. d. at 14″ = 16° divergence; at 20′ add. = 18°, abd. = 3°. Being also presbyopic, the following formula was ordered:

O. D. + 12 s. + 16 c. 5°, prism 4°, base inward.
O. S. + 12 s. + 48 c. 5°, prism 4°, base inward.

During two years he used these glasses, and found them helpful. He had persistent palpebral conjunctivitis, and other muscles besides the interni were feeble. He so far improved with the glasses as to reduce the insufficiency for 14″ v. d. from 16° to 8°.

Case XXXIII.—Mr. G., aged eleven, first seen in 1870. O. D. + 12 s. — 10 c. 180°, V. = $\frac{20}{30}$ (mixed astigmatism), O. S. + 36 s. V. = $\frac{20}{20}$; with glasses at 20′, add. = 9°, abd. = 8°. No record of Graefe's test for near. Suffers severe asthenopia.

Ord. O. D. + 12 s. — 10 c. 180°, O. S. prism 4°, base inward. In 1874 he had much improved, and there is a record that with v. d. at 14″ = 8° divergence.

In 1876 the record is that eyes are no longer painful, and with the right eye corrected he has v. d. 14″ equilibrium.

The next group of cases of muscular asthenopia are those in which the *recti externi* are at fault. These number sixteen, and in none was there converging strabismus. On the contrary, the symptoms were those of asthenopia, and for some of them the discovery of the cause was to me a great surprise. In some cases I had at a previous period made a false diagnosis, and was glad to have the opportunity of correcting it. The refractive condition of these patients is most various. Five have E. Three have H. One has M. Three have simple, and two have compound astigmatism. Two have E. in one eye and simple astigmatism in the other. Of the emmetropic cases, the inadequacy of the externi shows itself in the following relations between adduction and abduction:

No. 656 at 20′, add. = 27°, abd. = 3°, v. d. at 15″ = 10° conv.
No. 448 at 20′, add. = 26°, abd. = 3½°, v. d. at 14″ = 3° conv.
No. 291 at 20′, add. = 42°, abd. = 5°, v. d. at 14″ = 5° conv.
No. 189 at 20′, add. = 18°, abd. = 4°, v. d. at 14″ = 3° conv.
No. 128 v. d. at 14″ = 13° conv.

In some of these cases the prominent symptom was pain, in others intolerance of light, in others most obstinate palpebral conjunctivitis.

A most curious and interesting group of cases are those in which astigmatism excites weakness of the externi. For instance:

Case XXXIV., No. 752.—Has in both eyes — 48 c. 180°, V. = $\frac{20}{20}$, at 20′ add. = 20°, abd. = 10°, v. d. at 14″ = 10° convergence. The use of the cylinder abolished the vicious behavior of the muscles as well as the accommodative asthenopia.

Case XXXV.—My colleague, Dr. C., is a case in point, and kindly gives me the following statement of his condition:

27 Washington Place,
New York, *September* 29, 1876.

Dear Doctor: My case is a combination of simple myopic astigmatism with insuffiency of the externi.

The refraction is, right eye, $-\frac{1}{36}$ c. 10°, left eye, $-\frac{1}{36}$ c. 165°.

There is also a general myopia in the left eye of $\frac{1}{200}$ which may be practically disregarded. Vision = $\frac{20}{20}$ in both eyes when reduced by glasses to emmetropia.

With the astigmatism corrected by concave cylindricals, axis nearly vertical, a prism held vertically develops homonymous lateral displacemen

(insufficiency of the externi), just compensated by a prism of 5° for the far; for an object at twelve inches distance, the insufficiency under the same circumstances is 17°. Under these same circumstances, also, for the *near* (i. e., eyes corrected to emmetropia), there is now (age thirty-eight), and has been, for six years or so, asthenopia.

The reason is plain enough: The increased tension that the hardening lens requires of the ciliary muscle causes of course increased tension of the interni, and forms weakness of the externi. This increased action of the interni wheels the eye inward too far. In other words, with my eyes made emmetropic, I can focalize like any one of my age on near objects, but only (except with difficulty and pain) by squinting and homonymous diplopia.

Two ways of adjusting the relative accommodation present themselves —first, to correct emmetropia and supply a prism, to compensate for the inevitable squint for the near; or, instead of a prism, to supply a positive spherical glass, enough to take off the squint, producing tension of the interni, by relieving somewhat the ciliary muscle. The latter is obviously the simpler and cheaper way; and, as the required positive power has so far been $\frac{1}{36}$, I accomplish the object very easily by simply wearing a plain $+\frac{1}{36}$ cylinder with axis horizontal for near work. I am conscious, however, that I shall shortly need a little more power, as I find myself backing off from my book to fourteen inches and more.

My power of abduction is only 5°. My *adduction* is so enormous that I am afraid you won't believe me. I have just now not only overcome with the utmost ease all the prisms in my box put together (equal to 54°), but I have crossed the images and sent them flying away across the room. Once, some two or three years ago, I got two boxes of prisms, and by a powerful effort brought the images momentarily together through 90° of prisms—equal to a convergence of a right angle. I forgot to mention that, with plus cylindricals of $\frac{1}{36}$ which I wear for the near, the insufficiency for the near of 17° sinks to 8°, and the asthenopia disappears.

You are at liberty to quote this case in any way you will.

Yours in martyrdom, EDWARD CURTIS.

Case XXXVI.—One of my cases, a young girl, aged eleven, with —12 s. in one eye, and—8 in the other, had a degree of impairment of the externi, amounting to 27° at 20′, and had occasional diplopia. Frequent headache and nausea had been among her symptoms. I advised tenotomy of the interni, but she did not remain under my observation.

In only one of this group of cases have I performed tenotomy, and that case will be hereafter related. My judgment as to the true character of the cases now being considered has never been hastily made up. Their discovery was contrary sometimes to my expectations, and the correctness of my con-

clusion has been proved by the relief afforded by prescribing prisms with the bases outward.

The smallest group of cases consists of six, in which I found that the failure of equilibrium belonged to the muscles moving the globes upward or downward. It was not always practicable to individualize the faulty muscle, nor was it necessary. The discovery of such an error was made by trial with the red glass before one eye, and the candle flame. The flame was carried about all parts of the field, or the head moved in extreme lateral and up or down directions, while the flame was stationary. The search was for double images, of whose existence in any part of the field the patient had been unconscious. With this in mind, the examination was precisely the same as if the patient had made complaint of diplopia. In three cases there was a distinct diagnosis made of paresis of the inferior oblique.

Case XXXVII.—One of them had consulted me a number of times with complaints of irritation and pain in the eyes and eyelids, for which my suggestions availed little, and at length, while repeating previous examinations, I found diplopia on the extreme left side. Finally, the use of a prism 2°, base outward, before the right, and 2° base up and outward at 50°, gave the best relief which could be secured. His temperament was highly nervous, and slight annoyances were felt to excess. His condition was rendered much better than before.

Case XXXVIII.—In another instance, an artist, who had found great trouble in his eyes, had been supplied with convex spherical glasses by another surgeon who pronounced him a hypermetrope. His habit was to paint with his canvas close to his face. I found that his refraction was normal, but the weakness was in the superior oblique, whose capacity was much impaired. He was made entirely comfortable both for distant and near vision by wearing prisms O. D. 5°, base upward at 90°, O. S. 4°, base out and up 30°.

In this case there had been no complaint or suspicion of diplopia until my examination revealed it.

Case XXXIX.—Another patient was a lady, aged thirty-five, with M., O. D. $-\frac{1}{5}$ s. $\frac{20}{200}$, O. S. $-\frac{1}{6}$ s. $\frac{20}{50}$. There was extensive choroidal atrophy, both about the optic nerves, and in the right eye near the

macula. Her eyes were extremely sensitive, and she had made numerous attempts in vain to get comfortable glasses. I found that she had vertical diplopia, and gave her the following formulæ:

O. D. — 5 s. prism 4°, base upward 90°, light blue.
O. S. — 6 s. prism 2°, base inward, light blue.

This being for occasional use at a distance.

O. D. — 8 s. prism 4°, base upward 90°.
O. S. — 10 s. prism 5°, base inward.

To wear in the house, and to use in playing the piano and writing.

O. D. — prism 4°, base upward.
O. S. — prism 5°, base inward.

To use in reading. With these she had binocular vision.

She had an attack of rheumatism soon after my interviews, and for a month I did not see her. She then reported that the glasses had achieved a perfect success.

It is needless to relate the remaining cases in detail. They both had so much error as to need a suitable prism, and both were cases of compound myopic astigmatism.

The last subdivision of cases of muscular asthenopia comprises those in which many or all the muscles are enfeebled. Of them I note twenty-four. This condition may or may not be coupled with ametropia; in fact, twelve were cases of emmetropia. The evidence that such a condition exists is two-fold: first, and most important, a tremor of the eyes when turned to any extreme position, or in any attempt at fixation; and, second, inability to overcome a high degree of prism in any manner. The first symptom exists often when only one set of muscles is affected, but the second symptom is the one most decisive. For example:

No. 483 has E., V. = $\frac{20}{20}$ at 20′, add. = 12°, abd. = 4°, v. d. at 14″ = 0. No. 345 has + 48 s., V. = $\frac{20}{20}$, at 20′, add. = 10°, abd. = $4\frac{1}{2}$°, v. d. at 14″ = 4° divergence. All movements of eyes unsteady. No. 298 E., V. = $\frac{20}{20}$ at 20′, add. = 12°, abd. = 5°, v. d. at 14″ = 14° divergence.

In all these cases the power of adduction and also of abduction for distance is small, and for the near the divergence by

Graefe's test may be either nil, moderate, or considerable in amount. The notable point is, that no set of muscles is capable of demonstrating a disproportionate strength, but all are of inferior power. Our means of testing ocular muscles is less exact than can be applied to other muscles of the body. The latter can exhibit their capabilities by lifting weight, but our means of testing eye-muscles is confined to the exhibition of how much one set of muscles can antagonize another set, not what absolute force resides in each. The facts in the cases now brought forward show, however, that none of the muscles possess a high contractile power. A somewhat arbitrary limit must be chosen in defining these cases, and I have not set a rigid rule. Their behavior is somewhat peculiar; in one set are found persons in whom adduction and abduction at twenty feet are small, while divergence by Graefe's test at the near is also small; of these there are twelve cases, the adduction at 20′ varies between 7° and 12°, and the abduction between 2° and 6°, while the divergence at 14″ v. d. is never more than 7°. All these had much pain, and presented great difficulties in management.

Another portion of the cases, viz., five in number, differ in that they have a higher degree of divergence, with v. d. for the near, but both adduction and abduction at a distance continue small. I cannot discover a reason why, for the near, this difference should occur. It is not caused by difference of age, and consequently by failure of accommodation.

One patient, aged ten, with E., V. = $\frac{2}{2}\frac{0}{0}$, had at 20′ add. = 15°, abd. = 5°, and v. d. at 14″ = 12° divergence. She suffered extreme pain over the root of the nose, and at the inner canthi, and showed by the frowning of her forehead in reading the marked effort which she was making. Another, a teacher, aged thirty-one, with E., V. = $\frac{2}{2}\frac{0}{0}$, had at 20′ add. = 11°, abd. = 5°, and v. d. at 14″ = 11° divergence. He suffered great pain in using his eyes, but his better self-control prevented any outward exhibition of it.

Some cases with weak adduction and abduction for distance show equilibrium for the near; some have convergence for the near, or the convergence may, when the object is brought very close, give place to divergence. These differ-

ences must not be too strenuously insisted on, inasmuch as it seems to be of little moment what may be the behavior of the muscles in relation to each other when it appears that all of them are below standard. Of this whole class of cases the remark may be made, that they exhibit the symptoms of asthenopia in an exquisite degree. The signs of morbid nervous irritation are especially pronounced. The simple term pain does not adequately express the subjective sensations of the patients. Some of them show a kind of horror of looking at objects, and with very many the reaction upon the mind is especially morbid. If it happen that irregular refraction is combined with this weakness of muscles, and V. cannot be brought to $\frac{20}{20}$, the case will be likely to be of the most aggravated type. Certainly will this be true if the person possess a highly organized nervous system, or be suffering from ill health. A few cases, which have been the most utterly rebellious to any and all of my persuasions, have been of this kind; on the other hand, persons enjoying the most perfect bodily vigor may be afflicted with this infirmity of ocular muscles.

Case XL., No. 293.—A strong and healthy farmer-boy, aged nineteen, with Hm. $\frac{1}{30}$ S. $= \frac{20}{20}$, had at 20′ add. $= 18°$, abd. $= 4°$, v. d. at 14″ $= 0°$, v. d. with + 36 at 14″ $= 3°$ divergence. Has marked chronic palpebral conjunctivitis, and eyes tremble when he looks in the temporal direction. He had the advice of a competent ophthalmic surgeon, who had tried convex glasses and atropia, but the ocular pain persisted. His general muscular development should have been coupled with corresponding strength of eye-muscles, which was certainly not the case. His externi were in disproportion to the interni, but neither were as strong as needful.

Case XLI.—Another instance was a gentleman, aged twenty-four, whose physique was highly developed, and who had acquired reputation as a rifle-shot. He had E. and V. $= \frac{20}{15}$, his add. at 20′ $= 4°$, abd. $= 6°$, at 15″ add. $= 17°$, abd. $= 15°$, v. d. at 15″ $= 6°$ divergence. He suffered severely from blepharo-adenitis and chronic conjunctivitis, and could no longer use his eyes for the near, or practice shooting. Doubtless, his rifle practice had greatly aggravated his condition by exhausting his weak muscles. It is certain, however, that there was a primitive disproportion between his general and his ocular

muscular systems. His ocular muscles were greatly developed by using gymnastic prisms; his blepharo-adenitis was cured by treatment; he resumed his rifle practice, and has lately achieved special distinction at the target.

Case XLII.—One other case was Miss H., aged twenty, a leucophlegmatic looking person, who had had menstrual troubles, but from them had recovered, and was able now to endure a full amount of labor; she had a condition of eye-muscles most nearly approaching absolute impotence which it has been my misfortune to see. She had E., V. $= \frac{2}{20}$; in 1871, she had at 20′ add. $= 9°$, abd. $= 6°$, v. d. at 14″ $= 6°$ divergence, v. d. at 20′ $=$ equilibrium. In 1872, and again in 1874, she had at 20′ add. $= 3°$, abd. $= 3°$, with v. d. at 14″ $= 7°$ divergence, at 14″ add. $= 11°$. She not only had constant pain, but could not use her eyes for an instant without increasing her suffering. No methods I could devise ever gave her permanent help.

Treatment of Muscular Asthenopia.—I shall say little upon the constitutional and moral treatment which must be instituted in many cases of this trouble. Not that I fail to appreciate their great value; on the contrary, the assurance to the patient that his case is hopeful is of the highest importance; and suitable directions as to his manner of living, both in dress, food, exercise, sleep, and habits, form the staple of many a prelection in the consulting-room. Furthermore, the depressing influences of chronic disease, and especially of uterine disease, must be counterbalanced before marked improvement or cure of eye-troubles will follow. These truths are so well understood that I have no occasion to do more than express my appreciation of them. But these measures do not always, in my judgment, take first rank; they are constantly dwelt upon by intelligent general practitioners, and, when patients apply to the oculist, it is that he may point out the special *local* methods by which recovery of useful function may be secured. In rehearsing these special methods, it is my aim not so much to suggest new devices as to set forth, as precisely as I am able, the relative value of what we are accustomed to use, and their indications.

External applications were formerly the chief remedy for all kinds of asthenopia. Vaunted to excess, and often useless, they still have place and value. Such as relieve con-

junctival irritation, viz., the douche, the atomizer, hot or cold water, or both alternately, salt-water, solutions of borax, of morphia, and mild astringents, local applications to the palpebral conjunctiva—these are of undoubted service. Again, counter-irritation to the temples and forehead, by stimulating liniments, by veratria, and delphinia, and aconite, will sometimes divert a patient's attention from a disagreeable sensation in the eyes, or may allay the neuralgic irritation which radiates from the eyes. The same thing is accomplished by the fashionable galvanic battery, the constant current. None of these remedies would I underestimate, but I certainly deprecate their being held up to the patient as anything more than palliatives. Blisters and leeches have had their day, but now take an humble place, and serve only an occasional use.

The effective and rational treatment attempts to abate the amount of labor demanded of the muscles, and to directly increase their capacity. Graefe taught us the use of prisms and the indications for tenotomy, and how to make both prisms and ordinary glasses combine to relieve both refractive and muscular asthenopia. It was especially to muscular asthenopia complicating myopia that he called attention.

That he has written little upon the trouble as it occurs in other refractive conditions, was, doubtless, not because he had not studied it, but because he selected what is in reality the most urgent and commanding class of cases.

It appears to me of the first importance, in considering muscular asthenopia, to settle correctly what specific muscles are in error. I make this remark in view of the fact that, while the recti interni are by far the most frequently culpable, the externi, the obliqui, or the totality of muscles, may, as I have shown, be the occasion of trouble, and we are therefore bound to extend our investigation to the whole muscular system until we discover the exact error.

There are two ways of using prisms, which have distinct purposes. By one mode of employment, they diminish the labor of the muscles; by another, they can be made to augment the strength of muscles. When given for constant wear, the usual design is to abate the amount of work; but,

while they accomplish this, it will often be found that the overtasked muscles, when relieved of their intolerable load, are not only soothed but acquire greater strength. I have not seldom observed this result. On the other hand, it sometimes appears as if the muscular incapacity, for which prisms are prescribed, seems, by their constant use, to increase; certainly, in some cases, the quantity of insufficiency must be expressed by larger figures after a prolonged employment of prisms. I do not look upon this result as evidence of a real deterioration of muscular power; rather do I regard it as the suspension by the muscle of its excessive efforts, and subsidence to the degree of power which it is able to exert without strain. I find reason for this view in the fact that insufficiency soon ceases to advance, and, if the corresponding prisms are employed, entire comfort is secured. This condition has several times appeared in cases of myopics who have used abductive prisms. The externi have actually gained in relative control, but the symptoms of strain of the interni have abated, and, if anything more was requisite, either an addition could be made to the strength of the abductive prisms, or the case would be brought within the limits which would sanction tenotomy. I have seen the useful effect of prisms in strengthening muscles, in one case very strikingly.

Case XLIII.—Dr. McF., aged thirty-seven, asked my advice, in 1866, for muscular asthenopia. He had suffered since 1862, after recovery from fever. I found H. $\frac{1}{24}$, and did not use atropia. The symptoms of insufficient interni were so strong that I prescribed prisms, each 7°, bases inward, for constant wear. I also gave + 24 s. prism 8°, base inward, both eyes, for reading. I made no record of the exact state of the muscles. He had, however, had slight divergence since his childhood, but with the habit of trying to maintain binocular vision. It required some practice to use the glasses, but he soon adapted himself to them, and they entirely relieved his discomfort. Four years later, I found that his total abductive power for 20′ was 28°. He was perfectly content to wear his glasses, and declined to change.

I quote the doctor's own description, as given me lately in a note:

"About eighteen months ago, I began again to suffer pain, with at-

tacks of episcleritis, with considerable tenderness on pressure. I found I had astigmatism. When I first saw you, the divergence required for its full correction 28°, and the sight was very poor in the left eye, but I do not remember what it was. I can now fuse the images (at 20′) without any prisms, but cannot get along without them. My prisms have been reduced to + 24 s. ⊂ prism 5° base inward, instead of + 24 s. prism 7°, and I now employ the cylindric correction added to the prisms which you lately suggested. I get along with comparative comfort, although I feel the need of stronger prisms (i. e., than 5°), and the astigmatism of my left eye does not seem fully corrected ; to see right sharp, I allow it to diverge. The defect seems to be in the making of the glass, and not in the formula."

In 1876 I found he had the following ametropia: O. D. + 24 s. — 96 c. 85°, V. = $\frac{20}{12}$, O. S. + 15 s. — 36 c. 125°, V. = $\frac{20}{20}$. He was confident that the astigmatism had been acquired within a few years, and he himself successfully practises ophthalmic surgery ; he is also convinced that his interni have gained power while wearing abductive prisms.

Another remark, already incidentally made, may be here repeated, that prisms, which for a certain time have been helpful or essential, may become superfluous and therefore be discarded. This is frequent in mild cases, and among those whose asthenopia is mainly because of reduced health.

Another method of using prisms is as implements of gymnastic exercise. The idea of resorting to regulated exercise has been forcibly developed by Dr. Dyer. It is needless for me to quote his method, except to remark that he puts a patient upon a course of regular use of his eyes, beginning at the minimum period possible, and rising by small daily additions of one to three minutes to the attainment of two or more hours. He gives weak convex glasses or prisms, as may seem suitable. This practice invigorates the extrinsic muscles of the globe and the accommodation at the same time.

I have, within two years, gone a step in advance of this method, and directed the use of prisms to employ the extrinsic muscles alone and develop their capacity. I have the patient procure a set of prisms having the following angles 3°, 5°, 10° 10°, 15°. I usually give either the 3° or 5°, and sometimes both. The prisms are large enough to handle conveniently, and are

made quadrilateral, and their number scratched on them. I call them gymnastic prisms. The patient is instructed to use them daily upon an object fifteen or twenty feet distant, in a manner precisely like the way in which we test the muscular power in the consulting-room. He begins with the weak prism and rises by successive increments, putting one prism in front of another to the maximum which he can reach. He must so combine the prisms as not to make a greater jump from one to another than 3° or 5°, when the summit of his power is being approached. The above figures readily permit such combinations, the weak prisms being used to make the additions until it becomes easy for him to master 35° to 40° of adduction and 6° to 10° of abduction. It does not require more than ten or fifteen minutes spent in this way to give the muscles sufficient exercise, and such a session may be taken twice daily. It has surprised me to find how rapidly in most cases the patients surmount the difficulties of this labor. When they do accomplish the task, they feel conscious of a marked change in the behavior and function of their eyes. It is not sufficient to merely climb up to a high degree of adduction and abduction; there must be daily practice after reaching this stage of development for a period of weeks, to insure its permanence. To retain this power needs less expenditure of time each day than to obtain it. In this regard, ocular gymnastics closely resemble the experiences of ordinary gymnastic exercises.

The method thus indicated has been employed in nineteen cases. It is not inconsistent with any other methods of treatment, but on the other hand coöperates with them. Dr. Dyer's method and this may go hand in hand, while the permanent use of prisms or other glasses may also be a necessity.

To attempt more precise statements as to the employment of prisms, I will review the cases treated, and observe in the main the classification already made, beginning with weakness of the recti interni. The first series are the cases of emmetropia with weak interni.

These merge insensibly into those which I have mentioned as having weakness of all the muscles, and a strict line of demarcation is not possible in treatment any more than in

classification. To almost all these cases, the method suitable is a process of training combined with such a glass as will alleviate the labor of the muscles. Very seldom will the permanent use of prisms be proper, and still more rarely will tenotomy be indicated. The choice of prisms lies between giving them for near work or using them simply as gymnastic apparatus for the distance, as I have above described. Moreover, if used for the near, the question arises whether they should be plain or have a slightly convex surface.

As to the usefulness of a convex surface on prisms, I made considerable trial, being desirous of knowing how far the theories of Scheffler[1] would bear transplantation into the rugged soil of clinical experience. I found no satisfaction in his theory as a guide to practice, but some cases improved notably, and others did not. So far as I can discover from my records, among which the most unfortunate defect is the failure to state what was the patient's subsequent condition, the following conclusions seem justified. It is supposed, as is commonly true, that adduction and abduction for distance are both small. If, then, the divergence by Graefe's test be considerable, prisms amounting to not more than half this divergence will be proper as means of relief and training. If the person be very feeble in health, or be much above thirty years' old, the addition of + 60 or + 36 to the prisms will be more useful. If not required the patient will refuse it, because he will not relax his accommodation to the degree which the convex prism compels. If the divergence for the near be small and the patient feeble, a weak convex glass, + 60 to + 36, will answer better than prisms. They sufficiently aid the accommodation, and the muscles are also stimulated. If, now, the adduction or abduction for distance be small, and especially if the abduction be relatively high, while, for the near, divergence is above 6°, and especially if the person be in fair health, the *gymnastic prisms* for the distance are especially indicated. On this indication for their use I can speak confidently. To persons not vigorous they may answer a good purpose, but I think they are less effective. I have recorded

[1] "Physiologische Optik," Braunschweig, 1865.

some cases where abductive prisms combined with a spherical surface (say 4° + 36 s.) have done well, and been adhered to in reading for years. But I have, in several of these instances, discovered, upon later examination, that there was a latent H., which, at the time when the glasses were prescribed, was not discovered. I therefore am less inclined than formerly to give the convex surface, providing I can assure myself that there is no latent H. Within the past four years I have very seldom given them. In estimating how far a vivid imagination, or facility in language, or the habit of using strong epithets, colors the statements of such patients, it may be well to say that exaggeration is their common tendency, and fretfulness under their disabilities a frequent impulse. It is not always possible to restore them to as full enjoyment of their eyes as their inclinations may demand, and the art of the prescriber will often be taxed to induce contentment with what is attainable, and due appreciation of the comfort to be had in the assurance that no fatality to sight is impending. Besides the above uses of glasses, in some cases the Faradic current applied over the closed lids has seemed of some use, but I strongly doubt whether it did not derive its chief benefit from the impression of the treatment upon the patient's mind.

I regard the class of cases now under consideration as the most troublesome to manage, and they constitute a large proportion of the patients who come from the better classes of society; and they are abundant among studious young men and women. Of course, due cautions are demanded as to habits of life and social amusements, and use of eyes at night. Proper injunctions about light and rest, etc., etc., are to be given. But the injunction to abandon all use of eyes, I think, has been a hurtful fashion—in itself a needless hardship, and often mischievous in its moral effect. I am sure that many years of useful life have been wasted by mistaken advice of this kind.

What is to be said about muscular asthenopia with H. and with astigmatism is essentially the same as in cases of E., except in the addition of the needful correcting optical surface. Graefe remarked, in cases where hyperopia and muscu-

lar trouble combine, that the plus glass must be somewhat higher than would be needed if the muscles were strong.

On this point it is only needful to observe that proper choice of glasses will be readily made by testing the insufficiency after the patient has been provided with his ametropic correction. The insufficiency for the near will always be higher than without the correcting glasses. Conversely, however, it is by no means needful to give abductive prisms to cases of hyperopia who with their glasses show insufficiency for the near not more than 5°. That the muscular difficulty, when it is positively declared, cannot be ignored, is shown by the following case:

Case XLIV.—Miss B., aged twenty, whom I saw in 1870, and recorded her refraction as H. $\frac{1}{20}$, V. $= \frac{20}{20}$, had, without convex glasses, at 15″ add. = 24°, abd. = 16°, v. d. at 12″ = 8° divergence. I prescribed prismatic convex glasses 3° + 36 s., which she used for three years with much comfort; then, being married, she had, during two years, more trouble with her eyes, and, in 1875, I with atropine fixed the refraction at O. D. + 14 s. − 60 c. 125°, V. $= \frac{20}{30}$, O. S. + 14 s. − 60 c. 165°, V. $= \frac{20}{30}$. The muscle had improved so that at 20′ add. = 30°, abd. = 15°, v. d. at 14″ = 3° divergence. I gave the formula for ametropia without prisms, and the glasses proved unserviceable. The large amount of abduction at 20′ should have controlled the prescription, notwithstanding for the near, by Graefe's test, there was an insignificant insufficiency.

In cases of astigmatism, a complicated formula must sometimes be made, and it is a great comfort that mechanical skill has made these formulæ capable of exact realization, as was exhibited to the Congress, in 1872, at its session in London. A useful aid in managing these cases is to employ the method of gymnastic prisms for distance until the muscles reach the needful amount of endurance.

I pass to the consideration of insufficiency of the recti interni in myopia. On this topic the teachings of Graefe are classical; few of his precepts will not bear the test of experience. My own practice has led me to resort less freely to tenotomy than he sanctions, and to find greater help from prismatic concave glasses than he seemed to obtain. Of

course, my field of observation has been greatly inferior in extent to his, but one must abide by his own experience, and the difference of nationality and surroundings modifies clinical results.

It is comparatively easy to reach satisfactory results in dealing with muscular asthenopia in myopia. The indisposition to use their accommodation gives a handle which we can often seize with advantage. For example:

Case XLV., No. 248.—Has $-\frac{1}{12}$ s., V. $=\frac{20}{30}$, at 20′ abd. $= 7°$, at 12″ v. d. $= 11°$ divergence. Ord. $-\frac{1}{24}$ s. tinted blue for reading, and $-\frac{1}{14}$ s. for distance. The weak concave glass for the near removes the reading distance a little, and stimulates the accommodation. The indirect effect is to incite the recti interni to more efficient effort, and, as their converging point recedes, the asthenopic symptoms are removed, and no prism is employed.

It is needless to dilate on this matter. I will rather cite cases in which prisms have been successfully used, when it might have been thought needful to make tenotomy. The reasons for preferring the glasses to the operation were various. In some cases the patient was very timid or very feeble, or absolutely refused an operation. In other cases I felt uncertain as to the precision of the result, and one experience to be quoted has proved to me that a simple tenotomy may involve danger to the integrity of the eye. For other cases an operation was inexpedient because the persons were not able to remain long enough under treatment for its performance.

Taking the precepts of Graefe for a basis, as found in *Arch. f. Oph.*, Bd. viii., 2, S. 352–354, his suggestion of tenotomy for the cases in which by it the insufficiency is abated but not controlled, and for which prisms afterward do the remaining service, seems to me not to be always fitting. I should rather in many cases begin by obtaining with prisms all the gain possible, and afterward make tenotomy. It seems to me that the result is more satisfactory. To leave a patient after an operation in an incomplete condition is always a serious strain upon his courage and confidence. The matter is to him a momentous affair, and the good secured should bear some proportion to the effort demanded. It is, perhaps,

not necessary to argue this in full, as other reasons are equally influential. I may add that, in these very cases, satisfactory comfort is reached by prisms of a high degree, and they are by no means so unwieldy as might be thought, when the best mechanical skill is at command.

The following case is in point:

Case XLVI.—Mrs. P., aged thirty-three, in very delicate health, and of timid disposition, a person of high culture, had O. D. $-\frac{1}{3\frac{1}{2}}$ s., V. $=\frac{2\,0}{2\,0\,0}$, O. S. $-\frac{1}{3\frac{1}{2}}$ s. $-\frac{1}{16}$ c., V. $=\frac{2\,0}{1\,0\,0}$. At 20′ with $-$ 6 s. there was divergence amounting to 24°. For the near, there was habitual divergence; at a distance the axes were parallel. She had exquisite asthenopic symptoms, photophobia, pain in eyes, headache, nausea if she attempted to read or write. As compared with former years, her health is better. Sight always been myopic, yet could not use glasses because of pain and nausea. There was extensive circumoptical choroidal atrophy in each eye. I made application once of Herteloup's leech to each temple. Then ordered for each eye — 5 s. and abductive prism 8° of light-blue tint; the color was given by cementing a slip on the plane surface. I gave strychnia and other tonics, and directed a liniment of veratria to the temples. After two weeks, vision improved to $\frac{1\,2}{5\,0}$, and the glasses caused no discomfort. While wearing them the divergence (v. d.) at 8″ was 9°, for 20′ with v. d. it amounted to 12°. I then gave $-\frac{1}{4\frac{1}{2}}$ s., and abductive prism 12° for each eye, which was to be worn one hour three times daily; and gave $-\frac{1}{6\frac{1}{2}}$ s. prism 12° for reading. Six months from my first seeing her, I found that when wearing the distance-glasses she had equilibrium for distance, but, if a red glass were put before one eye, a divergence of 8° ensued, showing that the total defect was 32°. At this time I added a cylindric correction to the left glass. In 1874, which was two years after my first acquaintance with her, I found that, for distance, her abduction was 32°, or rather this was the dynamic divergence; for 8″ with glasses it reached 55°. She had some pain and sense of fullness of eyes in attempting to read, while the last note in November, 1874, states that she has but little ocular pain, and wears the reading-glasses for all purposes. Her health was excellent. I greatly feared mischief taking place within the globe, with so much choroidal atrophy, and used leeches a few times. In 1874, when the eyes had greatly recovered, I felt that tenotomy could be successfully done, and proposed it, but the suggestion was refused with alarm. She had a horror of any operation, and comforted herself in the

great relief which the glasses had procured. I did not take the weight of them, but they were made as small as possible, and the extreme concavity abated much of their cumbrousness. The increase of the abductive power under this treatment was coincident with the relief of distressing symptoms, and I did not regard it as in any wise to be deprecated. Most certainly, the case could have had tenotomy to advantage, after the training by prisms, but I am sure the operation would have set up great irritation and reaction if done at the outset. The tolerance of such high prisms was made easier by the considerable amblyopia as well as myopia. None of the distortion of objects which prisms produce was complained of, but she was obliged to learn how to estimate distances, and, before she could, many ludicrous mistakes occurred.

Another case with a cure by prisms is the following:

Case XLVII.—Miss L., aged fourteen, has O. D. — 6 s. — 34 c. 180°, V. = $\frac{20}{30}$, O. S. — 6 s., V. = $\frac{20}{30}$. With — 6 s. at 20′ add. = 15°, abd. = 15°, v. d. at 12″ with — 12 s. = 20° divergence, v. d. at 8″ = 25° divergence. Gave — 6 s. with abductive prism 4° for distance, — 12 s. with abductive prism 7° in reading. Examination after eight months showed that the uncomfortable symptoms had been removed, and the glasses for distance had become her sole dependence. She wore them all the time, and used them in reading. The state of the muscles is not recorded. The youth of this patient rendered a result practicable not attainable in later years.

Case XLVIII.—A similar result was gotten with Mr. R., aged nineteen, who, in October, 1873, had O. D. — $\frac{1}{12}$ s. — $\frac{1}{48}$ c. 115°, V. = $\frac{20}{20}$, O. S. — 12 s., V. = $\frac{20}{20}$, with glasses at 20′ add. = 12°, abd. = 6°; v. d. —12 s. at 14″ = 0., v. d. at 14″, no glass, = 8° divergence. Had irritation of eyes, pain, and conjunctivitis. Uses — 15 s. for distance. Gave for reading — 24 s. prism 3° base inward, both eyes. The glasses were used with benefit for several months, and then used only at intervals. After eight months he was found to have with the reading-glasses, viz., — 24 s. prism 3°, v. d. at 14″, 6° divergence. With — 12 s. distance 20′, add. = 20°, abd. = 15°. Found that with — 12 s. he could read from 20″ to 24″ easily, which formerly he could not do. He was advised to wear these constantly, and depend only on them. He found himself enabled with them to read four hours easily, and was glad to accept this relief. This case might have been designated for tenotomy, but I think the success of the

method not only justifies it, but that it is decidedly to be preferred as an experience.

Such cases prove what can be gained by optical methods, and I cite them not in disparagement of a proper resort to tenotomy, but to show that judicious use of prismatic glasses can accomplish more than has perhaps been thought attainable.

As to the employment of prisms as gymnastic agencies, their availability for this purpose was spoken of by Graefe in his paper, but he did not have satisfaction in their use, because he attempted to make patients wear prisms *constantly* which increase the labor of the weak muscles. *See Arch. f. O.*, viii., 2, 346. That this experiment should fail is not surprising. The method which I commend of brief periods of exercise is essentially different both in principle and result. Furthermore, it is true that prisms which *abate* the load laid upon weak muscles have the effect of increasing the strength of these muscles in a moderate degree by simply removing from them the worry of their task.

Case XLIX., No. 237.—Mr. C., aged nineteen, has O. D. — 10 s. — 16 c. 90°, V. = $\frac{20}{40}$, O. S. — 8 s. — 20 c. 90°, V. = $\frac{20}{40}$. He began to have trouble with his eyes at eight years of age. Was able to attend school only one winter. He has pain in his eyes all the time, can fix his sight upon no object without pain, and avoids looking as much as he can. With a red glass over one eye he has at 20′ 10° divergence and 12° vertical displacement. His eyes have irregular movements, and he has double vision on both sides of the field and below the horizon. He was wholly unfitted for either occupation or enjoyment. I ordered O. D. — 12 s. prism 6°, base inward, O. S. — 10 s. prism 4°, base downward. In three months I substituted for the left, — 10 s. prism 6°, base inward, giving him a total of 12° abduction in the glasses, and leaving out the vertical correction, which was now needless. After five months more I gave him the cylindric correction in addition. With them he began to read. During three years' employment of these glasses, and by such practice for near work as he could accomplish, the eyes grew more useful and comfortable, although far from satisfactory. In March, 1875, the record is with his optical correction at 20′ add. = 30°, abd. = 14°, at 14″ add. = 25°, abd. = 30°; v. d. at 14″ = 30° divergence. Under these conditions, the muscles having

gained greatly in steadiness of action, I advised tenotomy. I found, moreover, that better vision had appeared, with an apparent increase of myopia, viz., O. D. — 7 s. — 20 c., V. = $\frac{2}{20}$. O. S. — $5\frac{1}{2}$ s. — 20 c., V. = $\frac{2}{20}$. He feels greatly encouraged by his improvement, but has not yet consented to an operation.

To say anything in detail respecting prisms in cases of insufficiency of the externi, or of the muscles which carry the globes up and down, would be a repetition of much that has been stated. The same principles apply, and only this may be remarked, that the degree of the prisms must almost exactly correspond to the quantity of the deficiency.

Finally, I have resorted to tenotomy in twenty-one patients. To these I will call attention, both to indicate results and state some special experiences.

The statement of the cases in which tenotomy has been done as a relief for muscular insufficiency is as follows:

Tenotomy of Externi in Emmetropia		6	patients.
" " Hyperopia		2	"
" " Hyperopic Astigmatism and Amblyopia		1	"
" " Myopia		10	"
" Interni in Myopia		1	"
" " Myopic Astigmatism		1	"
Total		21	"

In four patients both externi or both interni were divided. In two patients the advancement of an externus was done in addition to tenotomy of an internus.

The amount of error to be corrected in the cases of E. was, as a rule, smaller than for M. This appears most notably in taking the displacement by Graefe's test for the near. The correction of the error was obtained with much more promptness after the operation in cases of M. than of E. In emmetropia there was a period of indecision in the attainment of the result which sometimes gave rise to considerable anxiety. This was true of only one case of myopia, and she was a patient so reduced by organic uterine disease as to have made the propriety of the operation doubtful.

In scanning all the cases, it appears that the effect of the tenotomy in emmetropia was a gain upon the original condi-

tion of from 8° to 13°; in myopia the gain was from 6° to 10°. This difference is noteworthy as showing that in E. the complaining muscles are relatively stronger than in M., and the effect of tenotomy is therefore larger. It is also notable what comforting relief was obtained in M. by slight alterations of muscular equilibrium. A difference of 6° was in three instances enough to establish entire comfort. In most cases the operation was made with great care, for fear of going beyond the limits of safe interference. The largest amount of permanent effect was 10° both for distance and near.

In all instances a suture was placed in the conjunctival wound, but made more or less efficient according to circumstances. In myopic patients the operation can be undertaken with less hesitation than in any other class, because the necessity for using glasses gives ready opportunity for adding such prisms as may be needed to render the results of the operation perfect. To a myope it is no hardship to wear glasses, to an emmetrope it might be quite different.

Case L.—It is, however, necessary to report that tenotomy done for a young myopic girl, twelve years old, was followed by the most alarming reaction. Inflammation attacked the capsule of Tenon and tissues of the orbit in great severity, and threatened the loss of the eye, but the ultimate result was satisfactory.

The state of health of the patient has a potent influence upon the result. The muscular conditions may be made satisfactory and no great comfort be gained, while the patient is suffering from debility, anæmia, uterine disease, or any depressing cause. I have experienced the force of this remark in several instances. It seems, however, that the operation is a wise step, and when the health pulls up, the relief to the eyes becomes most happy.

In the hyperopic patients I made a double tenotomy of the externi.

Case LI.—In one with H. $\frac{1}{36}$ the gain was 11°, and the final result was unknown, as he disappeared. In the other, H. $\frac{1}{3}$, the effect was surprisingly small, viz., 7°. It was, however, enough to give him comfort, his muscular power being small. A year after I found at 18′ add. = 10°, abd. = 3°. He constantly wore + 9, and though not able

to work all day his eyes were not asthenopic. The justification of the double operation was found in the intrinsic weakness of the whole muscular system of the globes.

Case LII.—In one case, a law student, who had marked anisometropia, viz., O. D. — 36 c. 90°, V. = $\frac{20}{30}$, O. S. + 12 s., V. = $\frac{20}{200}$, the muscular conditions were embarrassing. For the near the insufficiency was about 18°, although variable, the abduction for 20′ was 12°. Asthenopic symptoms were keenly distressing. I adopted the unusual course of performing advancement on the weak internus of the amblyopic eye—this was in January, 1870. The externus was not divided. The desired result seemed for a time to be attained. After two weeks the muscular conditions were as follows: at 18′ there was equilibrium, at 15′ there was 4° convergence. Gradually, however, the advanced muscle gave way, and four weeks later the situation had returned to almost precisely the same conditions as before the operation. In March I divided the externus of the same eye, obtaining, eighteen days after, equilibrium at 20′, and with v. d. 14″ 7° divergence. In November following, the same status remained. A year later, the effect of the operation for distance had increased to 4° convergence, and had diminished for the near to 11° divergence. He had attempted to go on with law studies, and was better able to work than he had been. I gave him adductive prisms 4° for distance and abductive prisms 6° for the near; also corrected the astigmatism. He was greatly annoyed by conjunctival congestion, and for six months he gave up study. Gradually an improvement took place until, in 1874, with a slight change for the better in the muscular formula, a marked gain in working power was reached. In 1875 he had no serious trouble in using his eyes, the conjunctival irritation greatly abated, asthenopic symptoms subsided, he used abductive prisms for the near, combined with — 36 c. 90°, and was in active occupation as a lawyer.

The extreme amblyopia of one eye was the occasion of the difficulty in conquering the asthenopia; while efforts of binocular vision were constantly painful, there was no disposition to abandon the eye to positive divergence. Probably the ultimate good result would have required two operations, and tenotomy of each externus would have been as effective as the advancement of the internus and tenotomy of the externus of the same eye, which I practiced.

Insufficiency of the externi is an uncommon accompani-

ment of myopia. For such a case I made tenotomy of both interni, and the history is instructive.

Case LIII.—Miss C., aged eighteen, in 1867 had O. D. — 18 s., V. = $\frac{20}{20}$, O. S. — 24 s., V. = $\frac{20}{20}$, at 20′ v. d. = 3° conv.

In 1869 there was at 12′ with glasses and v. d. 8° conv. She had homonymous diplopia for objects at the left of the median line. At 12″ she had adduction 38°. In March, 1869, I carefully divided both interni, doing it with experiments to test the effect obtained, and being guided by the behavior of the double images. The result was a positive gain of 6°, and the removal of all discomfort. Six weeks after the operation there was no diplopia in any part of the field, except at the extreme right a little divergence appeared, showing that the tenotomy had been carried to the full degree permissible. That the externi remained weak appeared by a little tremor when the eyes were moved far to the outer angles on either side. For nearly three years the patient enjoyed comfort in the use of her eyes. The myopia remained about the same. In 1872, while residing in Europe, she found some of the symptoms of the weakness of the externi return. She was not in health as good as usual, and she had always been slender in form and delicate in structure. She applied to a Swiss oculist, who divided again the right internus. After her return home I found that now there was weakness of the interni due to excessive tenotomy, giving for 15″ v. d. 6° divergence; that the myopia had increased and astigmatism had become notable. I ordered glasses to correct this new state of affairs, and she was measurably relieved of her annoyances. In 1874 I recorded her condition as follows: v. d. at 20′ = 10° divergence, v. d. at 14″ = 7° divergence, with glasses v. d. at 20′ = 2° div. With glasses at 20′, add. = 9°, abd. = 6°, O. D. — 16 s. — 20 c. 180°, V. = $\frac{20}{20}$, O. S. — 36 s. — 12 c. 175°, V. = $\frac{20}{20}$. These glasses express in the most significant way how the curve of the cornea had been changed by the successive tenotomies. Most notably had this effect been occasioned by the large interference of the European oculist. The fact is interesting in pathology and not without warning in therapeutics.

For the near I gave her O. D. — 20 c. 180° prism 4°, base inward, O. S. — 12 c. 175°.

She finds some trouble from the general unsteadiness of her eyes, but no acute trouble. Her temper is extremely placid, and she bears her inconveniences with equanimity.

The summing up of results in my cases of tenotomy is as

follows: Out of twenty-one patients, in one the result was unknown. Of the remaining twenty, seventeen had entire relief, and three obtained partial relief.

Among the seventeen cases of complete relief are two cases for whom two muscles were operated on. Among the three with partial relief, two had single tenotomy, and one had three tenotomies, as related above. While the above showing has an aspect of encouragement, I cannot avoid expressing my conviction that tenotomy in such cases must be done with great consideration and study of the exact muscular conditions. Graefe apparently acquired great boldness in its performance. Among our American population I think we must have more care in such interference. It is certain that the good result does not always come promptly, and this must be remembered. Especially is this true in emmetropia.

Case LIV.—For one emmetropic patient, operated on in 1867, I for a long time had the feeling that my services had been of doubtful value. In fact, the operation had too much effect. Five years after I gave adductive prisms to relieve the weakness of the externi, the interni having at first been the faulty muscles. This year, 1876, I am informed by her family physician that her eyes are perfectly strong.

Case LV.—On the other hand, one patient operated upon in 1867, when my appreciation of muscular asthenopia had not become as correct as afterward, whose adduction at 15′ was 9°, and abduction at 15′ 7°, was left with homonymous diplopia. Instead of regarding this as a misfortune he considered his condition an improvement, because he was relieved of pain. Two years later I operated on the same muscle by advancement, producing at the time crossed diplopia. In three weeks this had passed away, and he went home, his condition apparently better. The final result I have never known.

Case LVI.—In October, 1865, I was consulted by a young man, aged fifteen, with M. $\frac{1}{8}$, V. $= \frac{2}{20}$. He could read only fifteen minutes at a time, and had been distressed for four years. I gave — 12 s. with 4° prism, base inward, and with this aid he could in six weeks read three hours without pain. There still remained severe conjunctival irritation and some fatigue, and marked deviation when an object was brought within four inches. I therefore made tenotomy, although the precise conditions of muscularity are not on my record. The operation was done without anæsthetic, and the effect was moderate, so that I directed him to use the eyes on near objects during the first twenty-four hours.

For six weeks a little diplopia continued at a distance, but all tension and pain were removed. Entire relief from asthenopic symptoms was gained. In 1868 I gave the following optical correction: O. D. — 7 s. — 10 c. 180°, V. = $\frac{2}{3}\frac{0}{0}$ +, O. S. — 5 s. — 10 c. 180°, V. = $\frac{2}{3}\frac{0}{0}$ +. For reading, a glass, less concave by $\frac{1}{9}$, was given. In 1873 the state of the muscles was as follows: At 20′ add. = 27°, abd. = 4½°, with glasses v. d. at 14″ equilibrium. He began to use his distance-glasses for all purposes about this time. No change has occurred up to this time, 1876, in his refraction; his eyes work with entire comfort. A very energetic and excitable man, he is enthusiastic in praise of tenotomy as a relief for asthenopia.

Out of the experiences which I have gathered, the conclusion comes forcibly to my mind that asthenopia can be made to yield to a patient and skillful management; that its causes are largely local, and more manifold than have been apprehended; that small errors are capable under certain morbid states of health of exciting severe symptoms; that mixed astigmatism is more common than has been supposed; that errors compounded of refractive and muscular disturbances must receive complete correction; that a certain irritable or hyperæsthetic state of the brain, in which there are slight indications of hyperæmia of the base of the brain and upper part of the cord, is sometimes associated with asthenopia; that chronic nasal catarrh is capable of exciting a kind of asthenopia in suitable subjects. Added to these are various impaired conditions of the eye, such as beginning myopia, incipient cataract, beginning trachoma, etc., etc., which cause fatigue in vision which should not be designated as asthenopia, but which should be remembered as capable of causing symptoms quite similar.

A few words upon cases where there may be found irritability at the nape of the neck and base of the brain. These persons shrink from firm pressure over the spines of the upper vertebræ; they complain of slight jars of the head; they usually have much headache; often their digestion is feeble. In case any slight ocular errors exist, their effect for evil will be excessive. Such persons greatly need careful regimen, and often are benefited by bromides and strychnia and phosphorus. They will be found to complain of their eyes after any

tax of the brain or nervous system. The connection between mental worry and fatigue of the eyes will sometimes appear in a striking way. Not unlike these cases is a class which exists among both males and females, who cannot be better designated than as hysterical persons. They have exalted perceptions, emotions, and sensibilities; trifling errors become momentous in their influence; to them a judicious moral and medical treatment are equally important. Each of these cases must be conducted according to the best tact and judgment of the practitioner. It were needless to attempt to specify how, by exhortations and instruction, by prescriptions, by optical devices, by cheerful promises, by quips and jokes and wise trifles, such people are kept from making themselves needlessly miserable, and finally restored.

Thursday, September 14th, Afternoon Session.

The Congress was called to order by the President at 3 P. M., and the minutes of the morning session read and adopted.

The regular order of business was then opened by a paper entitled

A PRELIMINARY ANALYSIS OF TEN HUNDRED AND SIXTY CASES OF ASTHENOPIA,

OCCURRING IN THE PRACTICE OF C. R. AGNEW, M. D., NEW YORK,
Surgeon to the Manhattan Hospital, Clinical Professor of Ophthalmology, College of Physicians and Surgeons, New York, etc., etc.

WE do not propose to write a treatise upon asthenopia, but only to make a contribution to its clinical history. In order that the cases to be analyzed might be condensed into form, blanks have been prepared, ruled in columns headed as follows, viz.: Number, Sex, Single or Married, Occupation, Duration of Disease, Subjective Symptoms, Heredity, etc. Vision: *a*, without atropine or glasses; *b*, with glasses without atropine; *c*, with atropine, without glasses; *d*, with atropine and glasses. Correcting Glasses, without Atropine; Accommodation. Insufficiency: *a*, interni; *b*, externi. External Affections; Ophthalmoscopic Appearances; General Condition and Diseases of other Organs; Treatment and Results. Only such cases have been taken as had the fact of asthenopia noted in the records. More cases might have been added, in which errors of refraction and accommodation were discovered, but they are excluded, because there is no complaint of asthenopia recorded. This fact is partly due to the failure of some patients to give all the facts in their condition to the medical observer, and partly, no doubt, to the unintentional omission by the observer of such facts from the records.

We are all familiar with the varied forms of expression

used by asthenopes to describe their disability. They naturally seize upon that symptom which annoys them most, and give it prominence in the history of their case. If you, wishing to avoid leading questions, ask them to tell you in the fewest possible words why they seek advice, they will probably answer in some one of the following phrases: My eyes are weak; they burn; they blur; they give out; they water, and feel badly on reading, sewing, or writing; they have a strained feeling; they swell up or twitch; they become troublesome on use, and cause my head to ache; they make me dizzy; they give me pain in my back; they nauseate me; the eyes become dry; are sensitive to light; there are floating specks; the eyelids become red, and stick together in the mornings; I cannot use my eyes much at night, or when I feel bodily fatigue. Such expressions may be taken as the typical forms of complaint made by those whose cases are included in the records which form the basis of this communication. We regret that we cannot now publish the tables as they stand, that all might make their deductions from the statements which they contain. This is prevented, however, by the fact that the tables alone would make nearly one hundred octavo pages, and thus occupy a space in our proceedings far exceeding their value.

While there is a presumption in cases of errors of refraction and accommodation that asthenopia exists, it is by no means found to be so in practice. Your relator has, for instance, a very marked degree of latent insufficiency of the interni without ever experiencing the slightest asthenopia in any one of its many forms. Pain is always relative, and there are many subjects who unconsciously overcome physical defects in their visual organs without experiencing any abnormal sensation, and would have remained ignorant of such defects had not some accidental occurrence called their attention to a condition different from that existing in their neighbors. There are many people possessed of such power of adaptation that the unconscious exercise of the mentality of the senses carries them along in their daily use of the visual organs without pain or even inconvenience, even though they may have a decided error of refraction or accommodation. There are others who, with a very slight error of refraction or accommo-

dation, or without any error of either, will use all the strong adjectives they can think of to describe their deplorable state. It becomes a nice question of the exercise of judgment in such cases to say how and how much the eyes may be used in fine work.

Before the great reformation in ophthalmology, led by Helmholtz, Donders, and Von Graefe, such cases were largely treated as incipient amaurosis. Blisters, mercury, low diet, tartar emetic, blood-letting, applications of irritating alkaloids, such as veratria, to the circumocular parts and setons, were freely employed. Sometimes the sufferers were so subdued or silenced by the treatment that they ceased to complain of their eyes, preferring to endure the ills they had, rather than to endure those which the attempts to relieve their asthenopia led them to. So common was this method of treating asthenopia in this country, thirty years ago, that more than one clever, irregular practitioner made his fame and fortune in putting the exhausted subjects of it under hygienic rules, and giving them new life and hope by a generous dietary and free out-of-door life, thus showing how so-called quackery is often the natural offspring of our ignorance.

Among the lessons taught by the cases of asthenopia is the impressive one that very many of the subjects need careful medical and sanitary treatment in addition to that which is ophthalmic in its nature. It becomes, therefore, of the first importance that the observer should be much more than an oculist. He must be able, it is true, to say how much in a given case glasses or a tenotomy may be expected to do; but there is a factor in the case beyond the eye, the value of which must be applied before a cure can be expected. To do what is wise in such cases, the observer must also be well posted as to his own ignorance, and know when to call in other specialists to throw new light upon the case. He must, moreover, be up in all departments of hygiene, and know how to teach his patients how to become better tissue builders. It is here that the ophthalmologist and the specialist in diseases of women or of the nervous system may have to correspond. It is here that the expert ophthalmologist may resolve, with

a pair of spectacles, a case of asthenopia in which the neuroses of sensibility had led others to suspect grave disease of the nerve-centres. It is here that a wise gynecologist may skillfully relieve some uterine or ovarian condition and thus enable the ophthalmologist to reëstablish the function of vision.

Another most important lesson is, that the ophthalmoscope cannot be trusted to unveil the actual kind or amount of ametropia in asthenopia. I have often seen cases that had seemed to myself or others to be emmetropic, or slightly ametropic, under the ophthalmoscope, reveal even high degrees of ametropia when brought under the *full influence* of atropia. I have seen the decision of the ophthalmoscope reversed by the crucial ordeal of the *full* influence of atropia. I believe that it is incumbent, in cases of asthenopia, to nullify the accommodation before making a diagnosis as to the quality or quantity of the ametropia, and to defer the selection of spectacles until the accommodation shall have been reëstablished. In some cases it may be wise to keep the accommodation under atropia for several weeks. Such procedure will be often found necessary in progressive myopia, and in other forms of neglected or painful ametropia.

Where so many have thrown light on practice in this field, it may be invidious to make distinction, but there certainly can be no harm in saying how much we owe Ezra Dyer, M. D., for his suggestions on the subject of graduated exercise in asthenopia. A constant daily use of his method, commonly substituting two reading tasks for three, has been, in our practice, of immense value.

We can recall many cases where a persistent following of the plan of graduated exercise has even, after many failures, at last brought the patient out into a condition of ability to use the eyes almost *ad libitum*. But, as such remarks of a general nature might be prolonged almost indefinitely, we hasten to give the tables which throw into a condensed form some of the facts observed. Before doing this, however, we take pleasure in saying that, without the faithful and intelligent services of David Webster, M. D., the great labor involved in preparing the tables could scarcely have been performed. Many who hear me know his painstaking accuracy.

1,060 Cases:		Females:	
Males	457	Single	314
Females	603	Married	289

Table I.—Showing the number of asthenopes at different ages.

Age.	Male.	Female.	Total.	Age.	Male.	Female.	Total.
	No.	No.	No.		No.	No.	No.
8	1	1	2	38	11	15	26
9	4	1	5	39	5	7	12
10	3	3	6	40	5	20	25
11	3	7	10	41	5	5	10
12	5	3	8	42	3	10	13
13	3	4	7	43	6	7	13
14	2	8	10	44	3	7	10
15	10	11	21	45	4	10	14
16	12	17	29	46	4	6	10
17	18	16	34	47	6	5	11
18	27	27	54	48	5	9	14
19	19	18	37	49	2	11	13
20	17	21	38	50	5	10	15
21	26	15	41	51	3	4	7
22	24	15	39	52	9	7	16
23	15	17	32	53	0	4	4
24	12	13	25	54	4	3	7
25	23	18	41	55	3	4	7
26	12	19	31	56	3	0	3
27	18	18	36	57	2	2	4
28	12	14	26	58	1	3	4
29	7	25	32	59	0	5	5
30	9	24	33	60	1	5	6
31	9	17	26	61	2	1	3
32	13	20	33	62	3	0	3
33	18	16	34	63	1	0	1
34	9	13	22	65	1	0	1
35	7	14	21	72	0	1	1
36	6	11	17	Not noted	..	..	34
37	6	12	18				1,060

Table II.—Showing the occupations of male asthenopes.

Students	154	Engravers	2
Clerks	34	Carpenters	2
Lawyers	29	Missionaries	2
Merchants	28	Bankers	2
Clergymen	19	Traveling Agents	2
Physicians	18	Teller in Bank	1
Book-keepers	18	Stenographer	1
Teachers	6	Printer's Apprentice	1
Manufacturers	6	Type-setter	1
Engineers	5	Compositor	1
Cashiers	5	Stereotyper	1
Farmers	5	Publisher	1
Brokers	4	Naval Officer	1
Writers	3	Buyer of Goods	1
Traveling Salesmen	3	Colorer of Artificial Flowers	1
Editors	3		
Draughtsmen	2	Carried forward	362

Brought forward	362	Coachman	1
Nurse	1	Tax Collector	1
Porter	1	Jeweler	1
Restaurant Keeper	1	Examiner of Dry Goods	1
Fisherman	1	Purser on Ship	1
Wheelwright	1	Telegraph Operator	1
Architect	1	Tailor's Cutter	1
Post-Office Clerk	1	Grape Grower	1
Monk	1	Worker in White Lead	1
Treasurer	1	No occupation noted	74
Peddler	1		
Dentist	1		457
Piano Dealer	1		

TABLE III.—Showing the occupations of unmarried female asthenopes.

Students	76	Missionary	1
Seamstresses	17	Author	1
Teachers	19	Jewelry Polisher	1
Dressmakers	4	Apothecary	1
Domestics	3	Worker in Bank Note Manufactory	1
Nuns	3	Finishing Photographs	1
Writers	2	Physician	1
Milliners	2	Nurse	1
Retouching Negatives	2	Governess	1
Clerk	1	Fancy Work	1
Book-keeper	1	No occupation noted	172
Laundress	1		
Guardian	1		314

TABLE IV.—Showing the refraction of 1,060 asthenopes.

E. both	281	Am. both, equally	30
		Am. both, unequally	21
E. one, the other H.	36	Am. one, the other M. + Am.	7
E. one, the other M.	14	Am. one, the other Ahm	2
E. one, the other Am.	18	Am. one, the other Ah.	1
E. one, the other Ah.	7	M. + Am. both, equally	22
E. one, the other H. + Am.	1	M. + Am. both, unequally	31
E. one, the other M. + Am.	2		
E. one, the other Ahm.	3	Ah. both, equally	17
E. one, the other Amblyopic.	1	Ah. both, unequally	6
		Ah. one, the other H. + Ah.	2
H. both, equally	265	Ah. one, the other H. + Am.	1
H. both, unequally	94	Ah. one, the other Ahm.	2
H. one, the other M.	5		
H. one, the other Ah.	5	H. + Ah. both, equally	8
H. one, the other Am.	1	H. + Ah. both, unequally	6
H. one, the other H. + Ah.	8	H. + Ah. one, the other H. + Am	1
H. one, the other H. + Am.	2	H. + Ah. one, the other Amblyopic	2
H. one, the other Ahm.	1	H. + Am. both, unequally	1
H. one, the other irreg. astig.	1		
H. one, the other Amblyopic.	6	Ahm. both, equally	2
		Ahm. both, unequally	1
M. both, equally	74	Ahm. one, the other irreg. astig.	1
M. both, unequally	47		
M. one, the other Am.	5		1,060
M. one, the other M. + Am.	19		

TABLE V.—Showing the occupations of 112 out of 281 emmetropes.

Students	56	Farmer	1
Clerks	10	Manufacturer	1
Teachers	8	Editor	1
Lawyers	7	Broker	1
Seamstresses	6	Banker	1
Merchants	4	Cashier	1
Clergymen	3	Telegraph Operator	1
Book-keepers	4	Touching Negatives	1
Writers	2	No occupation noted	169
Engineers	2		281
Physicians	2		

TABLE VI.—Showing the various local complications found in emmetropic cases.

Hyperæmia of the Optic Papilla and Fundus	82	"Ripe Peach" Choroid	2
Insufficiency of Interni	71	Paresis of Ciliary Muscle	2
Slight Conjunctivitis	68	Chalazion	2
Venous Pulsation	57	"Phantom-like" Pinkish Clouds about Macula	2
Presbyopia	52	Redness in Region of Macula	1
Exaggerated Physiological Excavation	35	Slight Choroidal Atrophy	1
Delicate Changes about the Macula	11	Dust-like Lenticular Opacities	1
Peripheral Lenticular Opacities	5	Pigment-Specks on Anterior Capsule	1
"Phantom-like" White Spots in Region of Macula	3	Mydriasis	1
Injection of Ciliary Vessels	3	Slight Pterygium	1
Stillicidium	3	Blepharitis and Styes	11

TABLE VII.—Showing the various remote complications in emmetropic cases.

Uterine disease	15	Valvular Disease of Heart	1
Indigestion	8	Hysteria	1
General Debility	6	Otitis Media Suppurativa Chronica	1
Tobacco Poisoning	5	Enlarged Tonsils	1
Rheumatism and Neuralgia	4	Spinal Disease	1
Naso-pharyngeal Catarrh	3	Chronic Pelvic Cellulitis	1
Phthisis Pulmonalis	2	Chronic Diarrhœa	1
Malarial Poisoning	2	Psoriasis Capitis	1
Inanition	2	Stricture of Urethra	1
Pulmonary Hæmorrhage	1	Alcoholic Poisoning	1

TABLE VIII.—Showing assigned causes of asthenopia in emmetropic cases.

Over-use of Eyes reading	14	Rising at 4 A. M. and studying by Bad Gas-light	1
Reading late at Night and before Breakfast	3	Studying for "Cram Quiz"	1
Studying Nights	2	Preparing for College	1
Studying by Lamp-light	1	Reading during Convalescence	3
Reading from 7 A. M. to 7 P. M.	1	Eyes broke down at College	1

Eyes broke down at School	1	Severe Anxiety, Sleeplessness, and Mental Distress	2
Reading on the Cars	1	Over-use of Morphine	1
Studying Greek	1	Acting as Base-ball Catcher, facing the Sun	1
Strained Eyes doing Embroidery	1	Looking at Eclipse of the Sun	1
Working in Worsted	3	Exposure to Glare of Water	1
Sewing on Black	3	Exposure to Glare in Switzerland	1
Sewing on Striped Goods	1	Fall on Back of Neck	1
Sewing Day and Night	2	Measles	1
Running Sewing-Machine constantly	1	Scarlatina	1
Picking Hair for a Switch	1	Typhoid Fever	1
Examining Books by Gas-light	1	Fever	1
Copying Fine Notes by a Poor Light	1	Caught Cold in Eyes	1
Writing in a Basement by Gas-light	1	Self-Abuse	1
Wearing a Black Crape Veil	1	Attack of Dizziness and Vomiting lasting Two Days	1
Grief and Weeping for Loss of Relatives	2		
Loss of Sleep in Care of the Sick	2		

TABLE IX.—Showing the various local complications in hypermetropia, with its modifications.

Slight Conjunctivitis	113	Divergent Squint	5
Insufficiency of Interni	94	Paresis of Ciliary Muscles	3
Presbyopia	88	Stillicidium	2
Venous Pulsation	59	Slight Opacity of Posterior Capsule	2
Hyperæmia of Optic Papilla and Fundus	56	Slight Specks on Anterior Capsule	2
Exaggeration of Physiological Excavation	50	Chalazion	2
Blepharitis and Styes	23	Convergent Squint	1
Peripheral Lenticular Opacities	9	Dust-like Lenticular Opacities	1
Insufficiency of Externi	9	Cataract, one eye	1
Delicate Changes about Macula	9	Opaque Nerve-Fibres	1
Slight Choroidal Changes	8	Mydriasis	1
Staphyloma Posticum, or *Conus*	5	Spasm of Ciliary Muscle	1
Delicate Corneal Opacities	5	Scotoma	1
		Crystals of Cholesterine in Vitreous and Retina	1

TABLE X.—Showing the various local complications in myopia, and its modifications.

Slight Conjunctivitis	89	Mapping out of Staphyloma Posticum	3
Staphyloma Posticum	72	Minute Floating Bodies in Vitreous	3
Insufficiency of Interni	64	Insufficiency of Externi	3
Hyperæmia of Optic Papilla and Fundus	45	Opaque Nerve-Fibres	2
Venous Pulsation	38	Spasm of Ciliary Muscle	2
Exaggeration of Physiological Excavation	38	Delicate Corneal Opacities	2
Presbyopia	26	Paresis of Internus	1
Progressive Myopia	24	Mydriasis	1
Blepharitis and Styes	13	Opacity of Anterior Capsule	1
Delicate Changes about the Macula	9	Chalazion	1
Slight Choroidal Changes	6	Divergent Squint	1
Peripheral Lenticular Opacities	4	Occasional Divergent Squint	1
Scotomata	4	Slight Opacity of Posterior Capsule	1
		Color Scotoma	1
		Occasional Diplopia	1

TABLE XI.—Showing the remote complications in ametropic cases.

Uterine Disease	19	Hæmorrhoids	1
General Debility	19	Strangury	1
Indigestion	6	Neuralgia	1
Tobacco and Alcohol Poisoning	8	Chronic Bronchitis	1
Malarial Poisoning	5	Spinal Irritation	1
Rheumatism	5	Spinal Curvature	1
Hay-Fever	3	Hypochondriasis	1
Nervousness and Hysteria	2	Pulmonary Hæmorrhages	1
Facial Paralysis	2	Paralysis Agitans	1
Liver-Disease	2	Melancholia	1
Disease of Heart	1	Diabetes	1
Naso-pharyngeal Catarrh	3	Cancer	1

TABLE XII.—Showing the various assigned causes of asthenopia in ametropic cases.

Reading during Convalescence from Child-birth	13	Painting Days and reading Nights	1
Eyes broke down at College	9	Eyes broke down from reading an Old Book with Yellow Leaves by Kerosene	1
Measles	9	Eyes broke down while studying Law	1
Eyes broke down at School	7	Psoas Abscess	1
Writing by Gas-light	6	Looking at Eclipse of Sun	1
Studying by Gas-light	5	Injury of Spine from Fall	1
Reading on the Cars	5	Congestion of Brain	1
Blow upon One Eye	5	Rheumatic Inflammation of Eyes	1
Caught Cold in Eyes	4	Reading during Confinement with Uterine Disease	1
Glare of Snow	3	Wearing dotted Black Veil while traveling	1
Glare of Sun and Sand	3	Shock from a Fall	1
Watching with the Sick	3	Studying Greek	1
Grief and Weeping for Loss of Relatives	3	Asthenopia followed a Severe Attack of Vertigo	1
Scarlatina	3	Analyzing Flowers	1
Studying Hebrew	2	Studying German	1
Reading by Insufficient Light	2	Use of Black Crape Veil	1
Typhoid Fever	2	Studying by Tallow Candle	1
Reading during Convalescence from Miscarriage	1	Looking at the Sun	1
Peritonitis	1	Cerebro-spinal Meningitis	1
Strained Eyes doing Embroidery	1	Sewing and Weeping	1
Strained Eyes doing Fine Work	1	Got Cofetti into Eyes at Carnival at Florence	1
Small-pox	2	Allowing Infant to suck Eye while weaning	1
Reading by Kitchen Fire before Daylight	1	Commenced to study late in Life	2
Fall from Trapeze on Back of Head	1	Nervousness and Sleeplessness	3
Facial Neuralgia	1		
Eyes broke down while preparing for College	1		
Loss of Sleep with Sick Child	1		
Weeping and Nostalgia	1		

TABLE XIII.—Showing the duration of asthenopia in 746 cases.

Recent (less than 1 year)	226	17 years	2
1 year	88	18 "	2
2 years	70	19 "	2
3 "	56	20 "	5
4 "	42	21 "	1
5 "	27	22 "	2
6 "	34	23 "	1
7 "	14	24 "	1
8 "	12	25 "	2
9 "	6	27 "	1
10 "	20	28 "	1
11 "	3	29 "	1
12 "	7	34 "	1
13 "	5	From childhood and early school life	107
14 "	2		
15 "	2		
16 "	3		746

Dr. STRAWBRIDGE, of Philadelphia: Mr. President, I would like to ask Dr. Agnew, as his collection is such a large one, what his experience has been in the correction of cases of myopia by glasses? I would also like to ask, in those cases where he has tried the method of Dr. Dyer, whether he has insisted on the use of the eye, notwithstanding, perhaps, that the eye may feel great pain from such exercise? That is, whether he has pushed the eye day after day, notwithstanding that pain is felt, and, of course, increase of work would give it increase of pain. My own experience with the latter class of eyes is, that such an eye as a rule has a given capacity, and when it works up to that capacity improvement entirely stops. For instance, in a great many cases an eye may work up to two or two and a half or three hours a day, and then I am utterly unable to move it beyond such a point; and I would like to know Dr. Agnew's experience in that respect—whether he is able to push those eyes up to the full working capacity of a sound and healthy eye? In regard to the correction by glasses, for instance, whether in young persons he would fully correct the myopia or not, and also what his plan would be in persons of more mature years, say forty and upward?

Mr. CARTER: I should like to ask Dr. Agnew in what proportion of cases, whether in all or only in some, and under what circumstances, he thinks it necessary to use atropia in determining the condition of ametropia.

Dr. Agnew: I could not answer the last question without referring to the tables which show the cases in which atropia was or was not employed, but the general rule has been to employ atropia in order to paralyze the accommodation, except in very obvious cases. Where there was any difficulty in arriving at a conclusion, the atropia has always been resorted to. When a case of asthenopia comes to us, unless there is very obvious insufficiency of the interni, or a very obvious hypermetropia, which is easily discovered in the examination by the ophthalmoscope, atropia is employed, and I think that the experience has been that there has been no regret from its employment, and difficulties have remained unsolved where it was not used; so that, I think, in cases of asthenopia, it is better to err on the side of using atropia in order to include all the factors, so as to be able to determine just what, if any, degree of ametropia exists, because some of the worst conditions of asthenopia that I have seen have been those in which the degree of ametropia was comparatively small.

Dr. Strawbridge: The first question was as to the correction of myopia in young people, and, secondly, in old people. The second question was as to whether Dr. Agnew, in cases of asthenopia where a daily task of reading, or of any other work that the eyes are required to do, was given—whether that task is increased day by day, in spite of the eye beginning to become painful. In other words, whether he would increase it, notwithstanding the eye was becoming painful under the increased amount of work.

Dr. Agnew: In answer to Dr. Strawbridge, I would say it is impossible to fix arbitrarily what is a day's work; that will vary with different cases. You must, as far as possible, determine what will be a day's work for the given case, and that must turn on what changes are found in the eye. I think that, as a rule, in cases of asthenopia, many err on the side of yielding too much to the complaint of neuralgia on the part of the patient. Some of the most interesting cases recorded in these tables have been of persons who have complained of pain from the very beginning, who complained that the task of two or three minutes gave great pain.

My rule has been to persist in tasks of reading either a minute or two minutes a day, and then, after reaching a task of twenty-five or thirty minutes, to ask the question, "Does it hurt you any more to read twenty-five or thirty minutes than it did to read five or ten minutes?" and invariably, when they reply that it does not, to steadily increase the tasks. In some cases of asthenopia where the plan of Dyerizing has been employed, it has been necessary, after the patient had read twenty minutes or half an hour, to return to tasks of five minutes again, and to build up new tasks. With regard to the application of glasses, the rule has been in young persons to subject the eyes invariably, if sufficient time could be obtained, to the influence of atropia before determining the use of glasses. As a rule, we do not fully neutralize the apparent myopia in young persons. The plan has been, however, to give them the weakest glasses with which they could see $\frac{20}{20}$ after having subjected the eye to atropia.

Dr. Thomson, of Philadelphia: I would ask what is the correction in cases of hypermetropia; whether the doctor has his patients wear glasses for distant vision as well as near?

Dr. Strawbridge: I don't think Dr. Agnew thoroughly understood my question. For instance, we have a case of a young child, say ten years of age, with a myopia of say $\frac{1}{12}$, and a glass of $-\frac{1}{10}$, we will say, corrects that evil—what would Dr. Agnew do with that?

Dr. Agnew: Probably I should give that young child a glass of fifteen negative focal power, and permit it to carry it loosely and use it occasionally.

Dr. Strawbridge: Would you instruct such a case to use that glass for close work or simply for far work?

Dr. Agnew: For far work.

Dr. Strawbridge: Not for close work at all?

Dr. Agnew: No, though it might be used for reading music while playing. In answer to Dr. Thomson's question, I would say that, when the hypermetropia is great, you have to approximate the glass as quickly as you can which represents the total hypermetropia. I do not think there is any absolute rule. I think there are cases in which you may give a glass which is a compromise, as it were, and there are cases in which

you have to give two glasses, one to represent total hypermetropia, which they may use in reading, and another glass which is to be used for the distance, and I do not think there is any absolute rule in the selection of even hypermetropic glasses. It is well, if practicable in ametropia, to make the eyes as nearly emmetropic as possible.

Dr. Risley, of Philadelphia: I would like to know whether, in Dr. Agnew's experience, there has been any definite relation between the amount of choroidal change and the degree of nominal refraction; that is to say, in high degrees of simple astigmatism, either myopic or hypermetropic, has the change been relatively greater than in a lower degree of simple hypermetropic or myopic astigmatism.

Dr. Agnew: I don't think I could answer that from recollection of the statistics, but my impression is, if I understand the question, that, in cases of asthenopia, as a rule, the fundus changes are not very conspicuous, and that choroidal changes, when they exist, are more marked in high degrees than in low. This is especially true in progressive myopia.

Dr. Risley: I think my experience would teach me that the changes are relatively much greater in low degrees than in high degrees; that is to say, in a case of hypermetropic astigmatism of $\frac{1}{15}$, or even greater, or from $\frac{1}{20}$ up, that it is the exception to have much asthenopia, or very marked choroidal change, while, in the cases which are lower, there would be more marked asthenopia, and very decided choroidal change. I have been accustomed to explain it in this way: that in one case, by a combination of efforts, they were able to overcome the difficulty, while, in the other, it was a hopeless task, and they gave it up.

Dr. Loring: Mr. President, I would like to say a few words in regard to the correction of myopia. It has been laid down as an axiom for ten or twelve years that, as a rule, in young people, we ought to reduce the ametropia. It was certainly laid down in 1862 by Donders. I thought it was an axiom that the sooner we reduce the ametropia in a child's eye the better. I think that has been the practice of all oculists in this country during the last fifteen years, so far as I know. I am perfectly sure I have always done it. I think Dr.

Dyer has done it, and I think it is the universal custom of the country. In regard to the relation between the degree of ametropia and choroidal changes, I thought that, as a rule, it had been proved that the changes were greater, the greater the refraction; and I also thought that, the greater the error of retraction, the greater the strain, and it certainly has been my experience in all cases of refraction, except in some cases of hypermetropia of a very high degree, that the asthenopia was greater the greater the degree; and the reason, probably, is, as Dr. Risley says, that, so far as their distant vision is concerned, they do not make any effort to see clearly; but I cannot understand how anybody with a high degree of refraction can read a given amount of small type with less strain than a person with a low degree.

The next paper was then read.

ON THE TREATMENT OF ASTHENOPIA BY MEANS OF REGULAR SYSTEMATIC EXERCISE.

By E. DYER, M. D., Pittsburg, Pa.

In 1865, at the second meeting of the American Ophthalmological Society ("Trans. Amer. Ophth. Soc.," New York, 1865), I called attention to a peculiar form of asthenopia, for which I suggested a mode of treatment which I called "gymnastic exercise." Since then I have found this treatment useful, not only in cases of asthenopia where no errors existed, but also where the asthenopia was still persistent after the ametropia had been properly corrected. I am firmly convinced that asthenopia may exist entirely independent of ametropia, and that, in some of the most obstinate and distressing cases, the patient has been almost or entirely emmetropic. Dr. Hasket Derby has described this condition (*loc. cit.*, pp. 40, 41). "The eye is, to all appearance, both externally and ophthalmoscopically, absolutely normal. Paralysis of the accommodation fails to discover a vestige of hypermetropia. The interni are of normal strength. The general health may

be satisfactory—often, indeed, I admit, it is not. Sometimes, under the influence of an alcoholic stimulus, the symptoms temporarily disappear, or, under the excitement of important business, the eyes are used with apparent ease, and, when the excitement ceases, completely relapse into their old condition. This affection may last weeks, months, or a lifetime, and in the majority of cases resists any and every therapeutic agent. It is as little understood in our day as when Donders first wrote in 1858, and, when firmly fixed, as little amenable to treatment, an *ignis fatuus* among ophthalmic affections—in one case inherited, in another the result of imprudence, often absent in the invalid, and present along with the most vigorous health—a complete enigma as to its seat, its cause, or its cure."

Our means of determining errors of refraction and accommodation have become so exact that, when detected, we are too apt to assume that they are the cause of asthenopia, and to conclude that the correction of these errors is all that is necessary. In most cases, especially of hypermetropia, this is sufficient. But frequently it occurs that the asthenopia is still persistent. The pain and discomfort continue. One patient complains that he cannot wear the glasses, for they hurt his eyes; another that they afford him no relief. These cases are rare where hypermetropia exists, but are not infrequently connected with myopia. Donders describes a typical case, which I quote:

"Mrs. N., aged thirty-three, a nervous, weak, little person, complains that she cannot continue her work. She soon becomes tired, and suffers pain; the eye begins to weep, and she cannot resume her occupation during the entire day. In the evening, especially, she is obliged strictly to avoid all exertion; occasionally, too, some photophobia is present. I make her read; she holds the book at about 10″, and says she can still distinguish accurately when I bring it 5″ nearer. Already, I suspect that no H. exists. At a distance, V. appeared only $= \frac{1}{2}$; but, while positive glasses diminish still more the acuteness of vision, V. becomes $= 1$ with the use of $- \frac{1}{36}$; there is, consequently, M. $= \frac{1}{36}$. Closer investigation of her case shows that it differs in many respects from asthenopia by H. She has pain in the eyes themselves, which, properly speaking, always continues, and only increases

on exertion; the characteristic tension above the eyebrows is, on the contrary, absent; moreover, to the last moment, she sees acutely, and it is only the pain which makes her give up work. With these symptoms, there is now a slight irritation of the eyes persistently present. Ophthalmoscopic investigation reveals capillary hyperæmia of the optic nerve. Nothing more is to be seen. Such cases are not uncommon; they occur mostly with myopia, but they are also met with in other eyes. It is a not well-explained form of hyperæsthesia, in connection with symptoms of congestion. Blue glasses, resting the eyes, stimulating derivatives, etc., are only too often tried in vain. To refer such cases to asthenopia is to call two conditions, widely different both in essence and in symptoms, by the same name."

I cannot understand why the term asthenopia is not applicable here: *a* (privative) and σθενος (strength)—want of strength or power to use the eyes for continued work in the near.

I took my idea of systematic exercise from the meaning of the word, convinced that this form of asthenopia was due to muscular insufficiency for protracted work. All work for the near requires muscular action. There is a limit to the power of endurance of all muscles either in health or disease, but all muscles may be brought to perform a certain amount of work, which would be impossible without regular training by means of exercise with care and judgment. All gymnasts know this; and, whether a man trains himself or his horse for the best endurance and strength of muscle, the necessity of system is recognized. Overwork is as bad as no work at all. Every attempt at too prolonged exertion is followed by pain and fatigue. Our means of determining insufficiency of either the ciliary or oculi-motores muscles are quite exact for the time the examination lasts, but we have no means of determining the length of time that these muscles can be used without fatigue, nor can we in any way satisfy ourselves as to the value of the relative accommodation for protracted exertion.

To correct what I considered muscular asthenopia, I tried the method which, for want of a better term, I called "gymnastic exercise." The results have been satisfactory, and I am convinced that the functional insufficiency of one or all of the

muscles of the eye may be greatly diminished, if not entirely removed, and that their harmony of action may be restored by this method when others fail.

In cases of hypermetropia or marked insufficiency of the internal recti or astigmatism the proper correction must be made. In cases of myopia of less than $\frac{1}{10}$, glasses are not necessary. In the higher grades the far point should be carried out to ten or twelve inches. In emmetropic eyes I give a convex glass $\frac{1}{48}$ (.75 D.). This, though not apparently indicated, is of great assistance, for, though the relief to the ciliary muscle is but slight, the mental effect upon the patient is important.

The exercise of the muscles is best accomplished by reading. The patient is directed to select a book of good type, but not too absorbing, and to read regularly with the prescribed glasses three times a day. He must determine by trial the number of minutes he can read without discomfort. He may find this to be thirty seconds, five minutes, ten minutes, or perhaps more. He must, however, find the initial point. Starting at this point, he must read regularly, and always with the glasses (except in the myopes of $\frac{1}{12}$ circa). The first reading must not be until one-half hour after breakfast, the second at noon, and the third finished before sundown. The periods of reading must be regularly increased from day to day. No other use of the eyes should be allowed. In cases where discomfort occurs in less than five minutes, the increase should not be more than one-half minute per day until ten minutes are reached. In other cases the patient may increase one minute each day until he can read thirty minutes three times a day without pain. If this can only be done with pain, the patient must be encouraged to persist, notwithstanding the pain; the surgeon, however, exercising his judgment in not pushing the treatment too rapidly. Should the pain continue from one period to the next, it is evidence that he has gone beyond the maximum of his ability, and that he should fall back to a period at which he can read without discomfort, regard that as a new point of departure, and proceed as before. As said above, reading is the best exercise; but it frequently happens that the patient is very desirous to

write or sew. This may be attempted when thirty minutes has been reached, in the middle period. After the exercise has begun by reading ten minutes, sewing or writing may be tried for ten minutes, and the period finished by reading. From this point I permit an increase of two minutes a day, and a relative increase in the time of writing. This may be gradually introduced into the morning and evening period. I do not consider the treatment completed until an hour and a half is reached.

The benefit of encouragement in treating these cases I have explained in my previous paper, from which I quote: "I have found it of great assistance to explain the *rationale* of the treatment to the patient. These cases rarely occurring except in the educated classes, they readily understand it, and are anxious to assist the surgeon in the treatment. For this purpose, the new gymnastic exercise of the eyes is useful. I tell them that, in reading, pure muscular action is required as much as in lifting a weight; that, through want of use, general debility, or some derangement of the general system, they have lost the power to exert the muscle brought into action in reading without fatigue; that they can strengthen this muscle and increase its power of endurance by regular, constant, and systematic exercise, as well as any other muscles in the body. This course of treatment serves to distract the mind of the patient and restores his confidence in his ability to use his eyes. He has become discouraged; he has had the horror of blindness carefully instilled by friends and sometimes by well-meaning physicians, who, not feeling quite sure of their ground, err on the safe side, and prescribe entire rest. In these cases 'the safe side' is the wrong side. When the glasses are procured, and the patient is assured that there is no absolute disease of the eye as revealed by the ophthalmoscope, he commences his course of treatment with hope and zeal. The mere fact that he is told that he *must* use his eyes gives him, to a certain extent, the power to do so."

These cases of asthenopia are frequently connected with derangements of the uterine, digestive, or other functions, to which, of course, proper attention must be given. Tonics and

constitutional treatment are generally required. Veratria or aconite on the forehead and stimulating collyria are useful. I have also found great benefit from the use of the following powder as a douche. The powder should be dissolved in 16 oz. of water, temperature 70° Fahr., and the whole quantity used directly after each reading:

℞. Sodii chloridi, grs. xxxii.
Sodæ biboras, grs. xvi.
Tr. capsici, gtts. v.
Ol. menth. piper., gtts. ii.
Misce.

These powders must be carefully wrapped in tinfoil.

Conscious that I might be prejudiced in favor of this method, instead of quoting my own cases, I have written to my friend, Dr. Hasket Derby, asking him to give me his views of asthenopia and the value of gymnastic treatment, together with some cases from his own practice. In reply, he writes that during the last four or five years ninety-five cases have occurred in his private practice where he has used my method, of which there were

Cured	81
Total failure	7
Result not known	7
Total	95

He says: "The difficulty of inducing the average patient to give up all other employments and submit for three or four months to a rigid course of exercise and treatment fully accounts for the comparatively small number I have been enabled to follow up. I am convinced that the number of patients, with eyes apparently healthy, who are unable to read, write, or sew continuously, has been largely underestimated. It has been too much the custom for the surgeon, both in this and other countries, to insist on detecting evidences of tangible local derangement of function. Many seem to have found it impossible to grasp the fact that a healthy individual may have apparently healthy eyes, and yet be wholly unable to use them until the strength, lost by injudicious exertion, be regained by prolonged muscular training. Routine asserts

its sway: a glass is given here, a muscle pronounced at fault there, and the victim of this form of asthenopia dismissed with instructions to use his eyes in a way that will assuredly make them worse.

"The following are typical cases, selected nearly at random. It seems unnecessary to multiply the extracts from my records. I could easily give the histories of many instances of the effect of 'Dyer's gymnastic method.' Some of the individuals would be myopic, some hypermetropic, and some would have apparent insufficiency of the interni. They would nearly all be found to have lost the power of using their eyes continuously for the near after some unusual, prolonged, or injudicious exertion. In every case the neutralization of the accommodative over effort or muscular weakness would be followed by no relief. In over ninety per cent. of the cases the educated increasing effort would be followed by a cure. 'Morbid sensibility of the retina' was, ten years ago, the dread of the ophthalmic surgeon. Asthenopia that is neither accommodative nor muscular is, since you published your method, little more than a matter of routine treatment.

"Case I.—Miss W., aged thirty, came to me in September, 1864. Her general health was excellent. She had had no trouble with her eyes till during the past year. After prolonged use of them she began to notice pain and photophobia. The length of time she could read or write gradually decreased, till now she was able to use them but two hours during the whole day, and not at all by artificial light. The intolerance of light had become so excessive that even the reflection from a white handkerchief or cloth caused great pain. Eyes normal in every respect. I gave a tonic and a stimulant lotion, but lost sight of the patient for the next six years. In 1870 she returned, not improved; indeed, for three years past, she had not used her eyes at all, and was in the habit of passing the entire evening in the dark. Had been treated during the previous winter for 'inflammation of the optic nerve and retina.' I again found emmetropia, normal vision and fundus, accommodation perfect. She was given $\frac{1}{42}$ slightly-shaded blue; ordered to read with these glasses half a minute daily; not to use her eyes at all in the interval, and to have the constant current applied in the vicinity of the eyes twice a week. With much misgiving and many pull-backs she reached ten minutes thrice daily;

was then ordered to increase each reading by a minute, and, finally, toward the end of May, found herself able to read two hours at a time thrice daily. Her glasses were then discontinued. She, to-day, retains the full use of her eyes.

"Case II.—Miss G., aged thirty-six, well and strong. After doing a good deal of fine embroidery, three years ago, the eyes became excessively painful and sensitive to light. These symptoms steadily increased, till finally all work had to be suspended. In 1867, when I first saw her, she was 'unable to read a minute without pain.' No blur came on, but a dull, increasing pain in forehead and temples. Great photophobia, and entire inability to look out of the window of a rapidly-moving carriage, without considerable pain followed by nausea.

"Emmetropia, V. $\frac{20}{20}$, every function normal. She was ordered $\frac{1}{48}$ slightly-shaded blue, and to read with this one minute thrice daily, and to increase one minute every second day. A stimulant lotion and local application of electricity were further prescribed. She worked up to two hours thrice daily, relinquished then her glasses, and began to use her eyes at will. She has since written and published a book of some size, and remains well to this day.

"Case III.—Mr. P., a young clergyman, twenty-five years of age, came to me in September, 1873. General health always excellent. More than a year before, he had had an attack of conjunctivitis, after which acute asthenopia came on, and from that time to the present use of the eyes had been almost wholly suspended. Ten minutes' reading would bring on the most acute pain in the back of the eye, lasting, frequently, a portion of the day afterward. Being in Europe when first attacked, he consulted Prof. Alfred Graefe, at Halle, and subsequently, Prof. Leber, at Göttingen. They both diagnosed insufficiency of the interni, and Prof. Leber kindly wrote me out an account of the case. He found, at fifteen feet, a divergence of 8°, the double images being separated by a prism with the base up or down. At twelve inches there was an insufficiency of 18°, at nine inches of 24°. Tenotomy was advised. Mr. P. preferred to postpone the operation till his return to America. He tried prismatic glasses without relief, and resigned himself to entire non-use of his eyes, pursuing his studies by the aid of a reader. The symptoms all persisted, and, when he came to me, were as pronounced as ever. He was entirely unable to read or write without extreme pain. There was no blur or running together of the letters when he attempted to read, and no difficulty, except the pain, in the way of maintaining binocu-

lar vision at his near point. But, with a prism held base up or down, he certainly developed a dynamical divergence of 14° at ten inches, the existence of which would otherwise never have been suspected. There was emmetropia and normal accommodation. Satisfied that the asthenopic symptoms did not depend on the insufficiency, following as they had an acute inflammation, I ordered Mr. P. to commence Dyer's plan, using $\frac{1}{48}$, and reading half a minute thrice a day, increasing half a minute daily; also, directly after each reading, to use the cold douche, and then apply a stimulating liniment over the eye. With the utmost courage and perseverance the patient struggled against the pain induced by the reading, and persevered till able to read two hours continuously. He is now a hard-working clergyman, settled over a large parish, and uses his eyes freely without glasses.

"Case IV.—Miss H., aged twenty-seven, was seen in November, 1874. Five years ago, after doing a good deal of sewing, asthenopia manifested itself. Any use of the eyes on near objects was almost immediately followed by severe pain, radiating over face, forehead, and head, unattended by blur. In consequence, all work on near objects was given up. There was no marked photophobia; general health continued excellent. From year to year very slight improvement was manifested, but no continuous work could be done. Pain would ensue after ten minutes' reading, and the book have to be laid aside.

"I found M. $\frac{1}{48}$, V. $\frac{20}{20}$, no insufficiency of interni, ophthalmoscopic appearances normal. The constant electrical current was ordered to be applied to the eyes and head twice a week. She was told to read five minutes at a time three times a day, increasing one minute daily. On reaching one hour and eight minutes at a time, there was a slight tendency to relapse, and the patient was directed to go back to one hour, and to again add one minute daily. She now progressed uninterruptedly, reached two hours at a time three times daily, and has had entire ability to use her eyes without pain ever since."

These cases of Dr. Derby fully illustrate my method of treatment.

Dr. Derby, of New York: I have been surprised at the number of cases that presented the appearance of asthenopia with absolutely no changes of refraction to explain them, no error in the muscular apparatus of the eye, no changes that the ophthalmoscope showed to explain the very great trouble that the patient complained of. Learning yesterday that Dr.

Dyer was to speak on this subject, I took 116 cases of asthenopia from my private cases and analyzed them. I found accommodative asthenopia dependent on hypermetropia in forty cases, insufficiency of the recti muscles in thirty cases. In fourteen cases there was astigmatism, the correction of which relieved the asthenopic symptoms. In the remaining thirty-two cases, repeated examinations, both after the use of atropine and when no mydriatic had been used, failed to detect hypermetropia in any degree, or astigmatism. The usual tests for insufficiency of the recti interni, externi, as well as the superior and inferior recti, were used, but with negative results. Ophthalmoscopic changes, sufficient to explain the asthenopia, were not found. Many of these patients were emmetropic in both eyes. Myopia of $\frac{1}{8}$ in one eye, $\frac{1}{12}$ in the other, and lesser degrees of myopia, were found.

Among the symptoms complained of by these patients were pain in the back of the eyes after a few minutes' use, the pain often lasting for hours after the work was laid aside, and intolerance of light, especially of artificial light. The patients were of both sexes, nearly all of the better class of society, and between fifteen and thirty-five years of age. The treatment of these cases has been mainly the method which Dr. Dyer has prescribed, and to the benefit derived from it I am very glad to bear testimony. In absolutely all cases the relief has not been complete, nor have the good results attained been in all cases permanent.

Dr. Smith, of Detroit: I should like to know how long Dr. Dyer is in the habit of using atropia, and what strength of solution, before he comes to the conclusion that there is no hypermetropia? Just before leaving home, I had a remarkable case of hypermetropia simulating myopia. It was a patient with whom I had to use a four-grain solution of atropia for upward of three weeks before I cleared away the apparent myopia. The apparent myopia originally was something upward of $\frac{1}{10}$, and, after using a four-grain solution of atropia, between three and four weeks, the case turned out to be one of total hypermetropia less than $\frac{1}{50}$, and the benefit which she received from glasses was very marked. The asthenopia was

exceedingly troublesome before the refraction was remedied by glasses, and on giving her + 60 she went away, and I saw her a few weeks afterward and her symptoms were entirely relieved.

Dr. Dyer, of Pittsburgh: May I say one word that escaped me? Of course, any errors of accommodation, of insufficiency, etc., were always as nearly corrected as possible, but in the regular progressing work the glasses often apparently satisfied the conditions of the case, and, nevertheless, the asthenopia was just as bad as it was before.

The President then announced as the next paper:

CASE OF ECTROPION CURED BY TRANSPLANTATION OF A LARGE PIECE OF SKIN FROM THE FOREARM.

By O. F. WADSWORTH, M. D., of Boston.

I wish to report a case of deformity, in consequence of a burn, operated on successfully by a method recently proposed and carried out by Mr. Wolfe, of Glasgow; a method which consists in the transplantation of a large piece of skin, without pedicle, upon the surface of a fresh wound. Mr. Wolfe published, in the *London Medical Times and Gazette*, June 3, 1876, a brief account of two cases of ectropion thus operated on. This method offers so important an improvement in our means of dealing with deformities resulting from cicatricial contraction following injuries, that now, in its infancy, any instance of its successful application appears worthy of notice. It must prove particularly valuable in cases of destruction of part or the whole of the skin of the eyelids. At the worst, even if the transplanted skin should not live, the condition of the parts still remains as good as before the operation, while, if a flap taken from the neighboring skin sloughs, the effort of the surgeon has only succeeded in rendering the deformity greater than ever. The face, on account of the great vascularity of its tissues, offers a very favorable ground for the performance of the operation; whether it can be effectively employed in other parts of the body remains to be seen.

A healthy, well-grown girl, sixteen years of age, who had been burned on the left side of the face while an infant, was brought to me by her father in the latter part of July, 1876. A cicatrix, not generally very dense, involved all the skin in the neighborhood of the left orbit. The left eyebrow, its hair-follicles in part destroyed, was dragged downward so as to stand at a considerably lower level than the right; the upper lid was much shortened, and the lower so pulled down that its conjunctiva was completely everted. On attempted closure of this eye, a space remained open between the lids throughout their whole length, narrow at the outer part, but some 2‴ in width between the puncta lachrymalia. There was moderate thickening of the conjunctiva of the lower lid thus continuously exposed. The cornea had remained normal.

July 30th, the patient having been etherized, an incision was made through the skin of the lower lid, parallel to and $1\frac{1}{2}$‴ below the lashes. The inner extremity of the incision was just below the punctum, and it extended outward half an inch beyond the outer canthus. The tissues were then dissected till the edge of the lid could be easily raised sufficiently to meet the upper lid, and allow replacement of the everted conjunctiva. Then the two lids were fastened together by four sutures passed through their four edges. This left a raw surface $1\frac{5}{8}$″ in the horizontal and $\frac{5}{8}$″ in a vertical direction at the widest part. Next, a portion of skin was removed from the inner side of the forearm, about $2\frac{1}{2}$″ by $1\frac{1}{4}$″ in size. It was dissected off as cleanly as possible to avoid the presence of subcutaneous connective tissue, and, after separation, laid with its inner surface upward across the fingers of the left hand, while a few shreds of connective tissue, still adherent, were removed with curved scissors. Its inner surface, thus prepared, was quite as pale as the outer, very nearly smooth, dotted with minute depressions filled with fat-cells, and recalled, in some degree, the appearance of the outer surface of a side of sole-leather. It was scarcely more than $\frac{1}{2}$‴ in thickness. The shrinkage on removal was very considerable, and the detached skin, when spread out on the clean, raw surface of the lid, was barely more than sufficient to cover it easily. At this part of the operation a little difficulty was experienced, since the thin layer of skin tended to roll in on its under surface, and, to obviate this tendency, at one point below the outer canthus, where the surface of the wound made a double curve, two fine sutures, $\frac{3}{16}$″ apart, were placed. Gold-beater's-skin was laid over the lids, and covered by thick layers of cotton-wool, secured by a flannel bandage. The sound eye was also bandaged to secure immobility. The

edges of the wound in the forearm were dissected up and brought together.

The dressing was not disturbed for forty-eight hours. At the end of that time the bandage and cotton-wool were removed. Through the transparent gold-beater's-skin it was seen that the outer two-thirds of the transplanted piece lay quite smooth, its color normal, its edges in exact juxtaposition to those of the surrounding skin, while only a thin, dark line marked the boundary between them. There appeared to be absolutely no swelling. The inner third of the graft was somewhat uneven, and the inner two of the sutures, intended to hold the lids together, had broken away and allowed the lower lid to fall down a little. Some mucus and tears had run out from the conjunctival sack and smeared the innermost portion of the graft and the skin about it. To remove the mucus, a part of the gold-beater's-skin was cut away, and the skin washed with a weak solution of carbolic acid. A little cotton, moistened with carbolic-acid solution, was laid over the inner canthus, and packing and bandage renewed.

The next day the graft was everywhere in good condition, even at the inner corner, where it was a little raised, and appeared at first unattached; a minute fragment snipped off with scissors seemed alive. The gold-beater's-skin was removed on the fifth day after the operation, the bandage omitted, and the sutures holding the lids together removed on the eighth. The graft was now everywhere firmly united, and furrowed horizontally along its whole length by a shallow fold. On the tenth day I found the edges of the graft, at some spots, a little thickened, and paler, and feared suppuration might be taking place beneath; but this proved to be only the commencement of a throwing off of the horny layer of the epidermis, the same process as is well known to occur in the ordinary minute skin-grafts. It was five or six days later before the horny layer was thrown off over the whole surface.

The girl was sent home eighteen days after the operation. Union was everywhere perfect, the ectropion completely relieved, but the lids could still not be brought quite together for the inner half of their length. The graft then measured $1\frac{3}{8}''$ by $\frac{3}{8}''$.

The next paper was on

A CONVENIENT METHOD OF APPLYING WARMTH TO THE EYE.

By Dr. F. BULLER, Montreal.

When I first had the privilege of following the practice of the Royal London Ophthalmic Hospital, I found that in the treatment of nearly all ulcers and purulent infiltrations of the cornea occurring in in-door patients, the use of warm fomentations containing extract of belladonna was the sheet-anchor, and I was soon able to satisfy myself that those who were most assiduous in the use of the fomentations throve the best; but I also found that the apathy or indolence of the patient, and the multiplicity of duties devolving upon the nurses, too often rendered this plan of treatment most insufficient; moreover, it occurred to me that in applying warmth it would be desirable to maintain a uniform temperature during each application, which is obviously not the case when the patient is provided with a basin of warm lotion and directed to bathe the eyes with it until the fluid becomes cool. To carry out this object, and at the same time avoid the difficulties mentioned in the matter of nursing, I contrived a very simple apparatus which acts as a siphon, and is capable of supplying heat, either moist or dry, to any required extent.

The apparatus, for the idea of which I am indebted to Prof. Aitkins, of Toronto, consists of a tin reservoir with a capacity of three gallons, and a copper heater of the same height, but with a capacity about one-fourth as great. The two vessels are connected together above and below by short arms, the lower one of which is tubular, and permits the water to flow from the reservoir into the heater near the bottom, as fast as it escapes above through the siphon tube. The first two feet of this tube are made of metal, the remainder, about six feet in length, is rubber tubing, three lines in diameter, which is twisted into a coil at the middle, where it is attached to a thin sheet of flexible rubber about four inches square. The distal extremity is provided with a stopcock.

The end of the metal tube in the heater extends only

about two-thirds of the way down this vessel, so as to prevent the possibility of the latter ever running dry. By means of this contrivance, it is easy to apply any required degree of heat to the eye for any length of time, and that without any appreciable variation of temperature during the whole period of its application.

The *modus operandi* is as follows:

The combined reservoir and heater is placed upon a stand about the level of the patient's head, and both vessels are filled with hot water. A small gas-flame from a Bunsen-burner beneath the heater suffices to keep the water in this vessel nearly at the boiling-point.

The patient sits upon a chair, or rests in bed, at a convenient distance from the source of heat; a piece of lint is laid over the eye to be treated—wet or dry, as the case may be—and upon this the coil is fastened by a single strip of bandage around the head. The stopcock at the distal extremity of the tube hangs over a vessel placed upon the floor to receive the water as it flows away. The rapidity of this flow can be regulated to a nicety by means of the stopcock, and thus we have the temperature of the lint beneath the coil completely under control.

A thermometer bulb placed upon the inner portion of the upper eyelid will indicate about 150° Fahr. if the water be allowed to flow in a full stream, but, of course, this is a much greater heat than is ever required.

I have used this apparatus in the treatment of some thirty odd cases, most of which were purulent infiltrations of the cornea, with hypopyon, in elderly men, resulting from slight injuries. Though not always successful in arresting the progress of the disease, I can safely say the results were far more satisfactory than those obtained by the ordinary method of applying warmth. Three cases of purulent infiltration of the wound with hypopyon after extraction of cataract treated in this way recovered with surprising rapidity. Two cases of suppurative iritis following discission of soft cataract also did extremely well.

The experience thus gained has not been sufficiently large to justify any very positive conclusions, but I think—

1. The best results were obtained when the temperature was so regulated as to afford the greatest amount of comfort to the patient, and when the warmth was applied about half an hour at a time once in every three hours during the day-time, and a light compress bandage during the intervals.

2. That in some cases of purulent infiltration of the cornea dry heat acts far more beneficially than moist.

3. That, if the disease be not arrested in forty-eight hours, or, in other words, if the corneal infiltration is spreading and the hypopyon still increasing after a fair trial of the warmth, some other plan of treatment should be adopted.

4. That pain and intolerance of light are sometimes increased by either moist or dry heat applied in this way.

I think it is generally acknowledged that, when the surface of the cornea is ulcerated, the eyelids should be kept as much as possible at rest, and certainly this method has the advantage of securing such rest. The same may be said, with still greater reason, of those cases in which the edges of the wound become ulcerated or infiltrated after cataract operations.

Four or five patients can readily be treated with the same apparatus, and the labors of the nurse are thereby materially lightened; it is only necessary to see that the reservoir is kept filled and that the coil is properly adjusted—all the work of a few seconds.

The patients themselves were always very prompt in having their eyes placed under the machine, as they called it, at the stated intervals, and they seemed to regard the time so employed as a pleasant interruption in the monotony of hospital life.

It cannot be denied that the gas-flame burning in the ward tends to contaminate the air, and is especially objectionable in hot weather, but these objections are easily met by suitable means for ventilation; indeed, the heat of the gas-jet could easily be used to facilitate ventilation.

The want of some efficient means of applying warmth to the eye is probably not so often felt in private as in hospital practice, and it is only in the latter that I venture to recommend the use of this apparatus. It can easily be set up in any ophthalmic ward, and costs but a trifle. The rubber

tubing is the only part liable to get out of order, as it becomes too soft for use after two or three weeks' steady employment. The coils were made for me by Maw & Thompson, of Aldersgate Street, London. Any tinsmith can make the reservoir and heater.

Dr. Noyes, of New York: While I do not desire to detract anything from the merit of the suggestions of the gentleman, I would say that the same manner of employing warmth, as well as cold, to inflamed surfaces has been in employment in this city, and brought forward especially by Dr. Otis in the treatment of urethral disease. The same method is made useful in the treatment of inflammation of the eye.

The next paper was then read.

REMARKS ON THE CILIARY MUSCLE.

By EDWARD G. LORING, M. D., New York.

Ever since the discovery by Müller that the ciliary muscle could be separated into two parts, in one of which the fibres had, as a rule, a longitudinal and in the other a circular direction, there has been a tendency to attribute to these portions a difference in function, denoted by a difference in direction of traction. This opinion, checked for a time by the investigations of Van Reeken, received a new impulse from the labors of Rollett, Schultze, and Iwanoff. Thus it was shown by the latter that not only did the fibres have a different direction, so that they could be divided at least for the purposes of classification, but that the proportion in which these fibres occurred varied according to the optical condition of the eye, that is, with the refraction, and that this variation gave rise to a difference not only in the general shape and outline of the muscle, but also in its composite structure.

In the drawing (Fig. 1), taken from Iwanoff, the form of the normal, that of the myopic, and that of the hypermetropic eye are contrasted with each other. In this figure the solid

line indicates the shape of the emmetropic eye, the dotted line that of the myopic, and the broken line that of the hypermetropic eye.

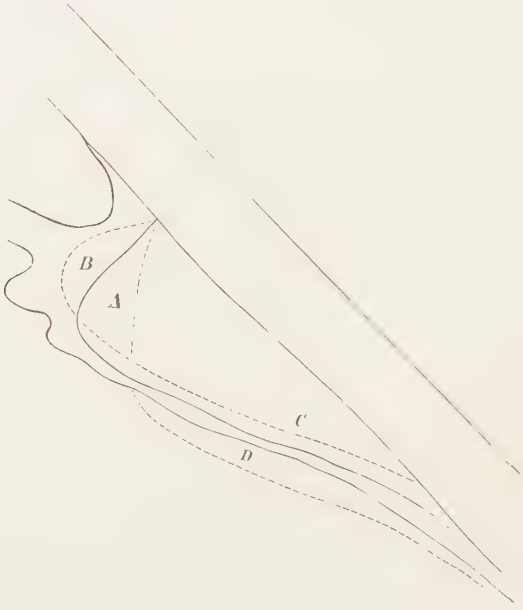


Fig. 1.

It will be seen that, whereas the short leg or side of the triangle, which the ciliary muscle forms as a whole, is, in the normal eye, nearly at right angles with the line of the sclera, that of the myopic eye forms an acute angle with the sclera, and that the entire triangle *A*, which the circular fibres occupy in the normal eye, is wanting. With the hypermetropic eye, on the contrary, the anterior portion of the muscle forms an obtuse angle with the line of the sclera, the triangle *B* being added. Furthermore, it will be seen that the myopic muscle, as contrasted with the normal, is longer, and the whole muscle is thicker, whereas the hypermetropic muscle is shorter, more advanced, and thinner. It was further shown that, in harmony with the difference in shape, the composite structure of the muscle was different under the microscope. Thus, in highly myopic eyes, the circular fibres, which occupy in the nor-

mal eye the triangle *A*, were found wanting, so that, according to Iwanoff, "the muscle of a myope is not simply atrophied, but only the circular bundles are affected by this atrophy, while the longitudinal ones, on the contrary, are hypertrophied, the reverse taking place, however, in the hypermetropic eye, since here we find also only one portion of the muscle hypertrophied, that containing the circular bundles."[1] That is the portion indicated in the drawing by the triangle *B*.

As the circular fibres were wanting in highly myopic eyes, which have no demands for active accommodative efforts, while on the other hand they were increased to a great amount in the hypermetropic eye, it was reasoned that these fibres exerted a predominating influence in active accommodation. The direction of traction of the two sets of fibres, as given by F. E. Schultze, and followed by Iwanoff, was, that the direction of traction of the circular fibres was, in the main, forward and inward toward the axis of the eye, while that of the longitudinal fibres was directly forward, meriting thus the appellation of a direct "tensor choroideæ." This agrees with the views of Helmholtz and most other physiologists who have expressed the opinion that traction on the choroid, and consequent relaxation of the zonula, forms one of the principal elements for the production of active accommodation.

As the circular fibres in the hypermetropic eye are hypertrophied at the expense of the longitudinal, the "result," as Iwanoff expresses it, "of the combined action of the muscle is only directed to a small degree from behind forward, but principally from without inward; while, on the other hand, the ciliary muscle of a myope must, by its contraction, exercise a considerably greater tension on the choroid than the muscle of the hypermetrope, so that, in the true sense of the word, it may be denominated a tensor choroideæ" (*loc. cit.*, p. 295). "As a tensor choroideæ," continues the author, "the muscle must exercise an influence on its two fixed points, which are respectively its insertion at Schlemm's canal *and its insertion at the optic-nerve entrance.*"

[1] "Beiträge zur Anatomie des Ciliarmuskels," *Archiv für Ophth.*, xv., 3, p. 292.

To account for the hypertrophy of the longitudinal fibres at the expense of the circular in the myopic eye, Iwanoff reasons as follows:

First, he assumes, since the circular fibres are found among animals, according to his investigations, only in pigs and apes, that they are an addendum in the higher animals only for the purposes of facilitating the act of accommodation. "In case of muscular disuse, atrophy will more readily occur in these accessory portions. This atrophy having once begun will develop itself more and more, since it is transmitted in an hereditary manner, together with an elongated, visual axis, till under the influence of this condition the muscle changes itself more and more into a tensor choroideæ, which now on its side calls forth a pathological elongation of the axis. With the progress of civilization new conditions of life appear. From such an eye, which has already become typical, an increased demand on the act of accommodation will be required, and the longitudinal fibres, the only ones now remaining, will become hypertrophied, in order to fulfill these requirements. The hypertrophied tensor choroideæ calls forth, then, an entire series of new pathological changes in the posterior part of the choroid, through which the progressive development of myopia is caused." [1]

However ingenious such reasoning as this may appear, it leads to but one conclusion, and that is, the apparent anomaly of the hypertrophy of a set of fibres to satisfy the demands of an enforced accommodation in an eye which does not require or use it, and the first natural instigation of which would be to suppress what it had. The only possible cause, then, for the hypertrophy of these longitudinal fibres would be for the purposes of negative accommodation, which conclusion is, to use the words of the author, the *reductio ad absurdum*, since a myope cannot carry out his far point by any accommodative strain. It would, moreover, certainly appear very far fetched to attribute this hypertrophy to an effort on the part of the longitudinal fibres to hold in check active accommodative efforts produced by the circular fibres, since in a myopic eye no such efforts are made or needed. From the very formation of the globe

[1] *Archiv für Ophth.*, xv., Ab. 3, p. 297.

no accommodation at all would be used in the very eyes in which this hypertrophy of the fibres was found most developed, that is, in such eyes as were examined by Iwanoff, all of which were of an excessive degree, the shortest being twenty-eight and the longest thirty-four mm., M. being $\frac{1}{2.5}$ or greater; and all the more would this be true if we accept, with the author, that this condition of the muscular fibres is to be found by preference in such eyes as have always been highly myopic.

It would certainly appear, then, illogical to attribute the hypertrophy of the longitudinal fibres in a myopic eye to any action on the part of the accommodation. To what, then, are the increase in size and the variation in its component parts due? Without presuming to answer this question as to the cause *in toto*, it has nevertheless struck me that a very important factor, and one which might produce a marked effect, not only on the shape of the muscle but also as to its appearance under the microscope, so far as the directions of its fibres are concerned, has been neglected in the consideration of this question. I allude to the mechanical effect of distention of the enveloping membranes of the eye, which, in some cases, is enormous; as, for example, where progressive myopia is developed very rapidly and to a high degree. Thus, if the posterior part of the eye yielded, the insertion of the muscles at its choroidal end would be drawn back, as seen in the drawing (Fig. 1), and the muscle would thereby be increased in length.

The angle, which was in a normal eye a right angle, would by this backward traction become acute, since the insertion around the canal of Schlemm would remain stationary, while the apex would be drawn back. Moreover, as the vertical and horizontal diameters are increased by this general distention of highly myopic eyes, the zonula would be stretched, not only in an antero-posterior direction, but also horizontally and vertically. There would then be a gentle but constant traction on the muscle, the direction of the force being away from the axis of the eye. Thus, the fibres would have a tendency to draw apart and the muscles become thereby increased in size. This tension on the zonula, in a direction more or less at right angles with the axis of the eye, would account also for the

fact that the lens is flatter in high degrees of M. than in the normal eye.

A change would also occur for the same reason in the direction of the fibres of the muscle. The so-called circular fibres, which are few in number, and which form an anastomosing network, the meshes of which run more or less perpendicular to the direction of the longitudinal fibres, would, on being stretched, assume precisely the opposite direction, and then have on section the same general direction as the longitudinal fibres.

In the hypermetropic eye, however, the reverse would take place. As the eye itself is, as a whole, an undeveloped eye, the muscle, as a whole, would be smaller, and especially would it be shorter along the sclera (*C*, Fig. 1). Moreover, as the demands on the accommodation are increased from the very structure of the eye, the muscle, from constant exercise, would have a tendency to increase in volume over what it was originally, and be pushed forward (*see B*, Fig. 1). As the sclera in these eyes does not yield, the muscle would become more compact, and many fibres, especially the oblique and radial, would, from this fact, assume a direction while growing which they would not have in the normal eye. The network would be pressed closer together, that is, in an antero-posterior sense. From this it would result that there would be apparently a greater number of circular fibres on section than in a normal eye.

This will be better understood by a reference to the drawings of the three varieties of the muscle, as recently published by Iwanoff, in the "Handbuch der gesammten Augenheilkunde," B. i., Ab. 1, p. 271; also by F. E. Schultze, *Klin. Monatsblät.*, 1866, p. 390.

From such considerations I would conclude that the differences in shape and structure of the muscle, as regards refraction, were rather due to mechanical conditions, such as traction and condensation, than to difference of function of the component parts of the muscle.

In regard to the functions of the muscle, it can be said that it has never been demonstrated that the ciliary muscle exerted the slightest traction on the posterior parts of the

choroid, as claimed by Iwanoff in the passage just quoted. Indeed, the little experimental evidence which we have is against such a supposition, as is, indeed, all clinical evidence. There is, moreover, a strong doubt whether the muscle exerts any traction even on the anterior portions of the choroid, and some of those who have been the most enthusiastic supporters as to the meridional portion being a direct tensor choroideæ seem to have modified if not completely changed their views. Thus, Iwanoff, formerly a warm supporter and advocate of the theory of traction on the choroid, now takes a precisely opposite view. For, after describing the anatomy of the meridional portion and its connection with the L. supra-choroidea Iwanoff writes as follows: "It is evident that, with such an arrangement of the meridional portion of the muscle with the lamina supra-choroidea, and with such a structure of this latter, that the deeper layers of the choroid—chorio-capillaris and middle choroidal layer—cannot be essentially stretched, consequently the entire effect of the contraction of the ciliary muscle will limit itself to an extension of the ciliary body, which, as is known, is in the closest connection with the zonula of Zinn, while, in the choroid, at the most, only a stretching of the lamina supra-choroidea will take place. This fact is perfectly intelligible when it is borne in mind that that part of the choroid which lies behind the Ora *serrata* has no direct connection with the zonula" (*loc. cit.*, p. 277).

Against the theory, supported by many, and thus formulated by Warlomont,[1] that "the circular fibres of the muscle alone produce accommodation, while the longitudinal ones reëstablish it for the distance," we have what would appear to be strong if not conclusive proof in the anatomy of the muscle itself. For, if we turn to the later drawings of the normal eye by Iwanoff (*loc cit*, p. 271), we shall see that the circular fibres bear such an insignificant comparison, as to size and extent, with the rest of the muscle—meridional and radial portion—as to be hardly noticeable in the drawing.

To assume that these few fibres perform the entire function of active accommodation, while that part of the muscle which outweighs them a hundred-fold is employed to reëstab-

[1] *Annales d'Oculistique*, May and June, 1875.

lish the accommodation for the far (active relaxation), would certainly appear contrary to all anatomical analogy. Very striking is the difference in the drawings of the ciliary muscle given by Iwanoff and Warlomont, so far as the circular fibres are concerned, in the normal eye. For, while that given by the former in his later work, just quoted, shows but a few very fine and hardly recognizable fibres, that given by Warlomont shows more than one-third of the entire muscle occupied by them (*Annales d'Oculistique*, May and June, 1875, p. 201).

Worthy of remark also is the statement made by Iwanoff in regard to some later examinations made by him, concerning which he observes: "These latter examinations have convinced me among other things of this, namely, that these two types of muscles are not absolutely and necessarily joined with a condition of short-sightedness or far-sightedness, since I have, at least, in far-sighted eyes, met with ciliary muscles with a weak development of Müller's fibres."

From what has preceded, it would seem to follow that further investigations into the anatomy and physiology of the ciliary muscle were indispensable to a true knowledge of its functions.

A paper was then read entitled

A CASE OF SUBCONJUNCTIVAL CYSTICERCUS.

By CHARLES J. KIPP, M. D.,
OPHTHALMIC SURGEON TO THE HOSPITALS IN NEWARK, N. J.

The case I am about to relate derives its interest exclusively from the fact that it is, so far as I am aware, the first case in which a cysticercus cellulosæ has been seen in or about the eye in America:

The patient was a robust German, twenty-three years of age, who had been but a few years in this country. His health had always been good. There had never been, and there were not at the time he came under observation, any indications of intestinal worms of any description. His skin was entirely free from tumors. He had been in the habit of eating raw or nearly raw meats.

His left eye had pained him for some months, but at no time so

much as at the present. On examination, the lids and surrounding parts were found to be normal. The eyeball was very slightly protruded, and squinted outward about 2″. Its mobility was impaired considerably inward and somewhat outward, but upward and downward it was normal. The vision of the eye was $\frac{2}{20}$, Tn.

The ocular conjunctiva was intensely injected and somewhat swollen. Between the inner margin of the cornea and the caruncle was situated a yellowish-red tumor of about the size of a large cherry-stone. The tumor was covered by the conjunctiva, which was thickened, opaque, and very hyperæmic. The tumor was elastic, and could be moved to a limited extent over the sclerotic, but could not be lifted from it.

A careful examination of all the other parts of the eye showed them to be healthy.

The treatment consisted of a horizontal incision of the conjunctiva over the middle of the tumor, and the extraction with a pair of forceps of a round, bladder-like, slightly-yellowish body which protruded through the incision. The microscopic examination made immediately after the operation showed the tumor to be a cysticercus cellulosæ, with head and neck complete.

The wound healed by first intention. The conjunctival injection and the pain had entirely subsided four days afterward, but the globe was still slightly protruded, and its mobility somewhat impaired inward and outward. Four weeks later all traces of the exophthalmos had disappeared, and the mobility of the globe was normal.

The President: I understand Dr. Kipp to say that this was the only case published in this country of cysticercus in the eye?

Dr. Kipp: So far as I know.

The President: Ten or twelve years ago I published an account of a case of cysticercus in the vitreous humor, just behind the crystalline lens. The cyst and the whole appearance of the object was one of cysticercus, but it was impossible to see the movement of the animal, or any movement of its head, so as to identify it. I published it, however, as a case of cysticercus of the eye, the only one that I have ever seen where it was at all probable.

The next paper was then called for.

NOTE ON INHERITED EFFECTS OF LESIONS OF THE SYMPATHETIC NERVE AND CORPORA RESTIFORMIA ON THE EYE.

By EUGENE DUPUY, New York,

M. D. PARIS UNIVERSITY; CORRESPONDING MEMBER OF THE SOCIÉTÉ DE BIOLOGIE OF PARIS; MEMBER OF THE AMERICAN NEUROLOGICAL SOCIETY; FORMERLY PROFESSOR OF PHYSIOLOGY IN LONDON, ETC.

Somewhat more than three years ago my friend and teacher, Dr. Brown-Séquard, undertook a series of experiments with the idea of ascertaining certain conditions of transmission of nerve-lesions from parents to offspring. We observed together, among many other interesting results published in the "Comptes Rendus" of the Société de Biologie of Paris, the fact that almost every lesion of the sympathetic in which the system of the eyeball is involved, directly or indirectly, is transmitted from parents to offspring.

I have since divided the sympathetic nerve in the neck on a pair of Guinea-pigs, and observed the usual effects of such an operation, i. e., semi-closing of the eyelids, hypersecretion of tears, contraction of the pupil, elevation of temperature on the side of the face operated upon, and drooping of the ear.

These animals very soon recovered from the effects of the lesions, so far as the wound was concerned. It closed very rapidly, and the elevation of temperature did not remain very appreciable; but the other effects of the section of the nerve remained permanent.

A few months after, this pair of animals, still presenting the same phenomena as above, gave birth to a number of young, which all presented the effects of the section of the sympathetic to such a remarkable degree that one would have said that they also had been operated upon. Their eyelids were half closed, the pupils of the eyes were very small, the ocular globe itself was smaller than it is in animals born from parents not having suffered any operation; the ears were thicker and larger than usual, and covered with heavier hair. The only difference between these animals and their parents consisted in this, that the rudimentary nictitating membrane was not observed to be in a paralytic condition, and there was no abnormal secretion of tears, as with the parents, nor was

there any elevation of temperature noticeable. There was in a number of cases opacity of the cornea, but never ulceration, and sometimes cataract.

I had operated on the right nerve in the male, and on the left in the female parent. The offspring showed the phenomena in both eyes. In another series of experiments I operated on the nerves of both the animals on the left side, and the offspring had the phenomena sometimes only in one eye, sometimes in both. I leave out purposely other symptoms observed in other parts of the head. When I operated on the nerves of the right side in both parents, the phenomena in the young always existed on both sides.

Those young, which were born with the two eyes bearing hereditary deformity, were put together and allowed to breed among themselves. I have followed thus through five generations the reproduction of these phenomena brought on in the original pair by section of the cervical sympathetic; and, at that time, a female with the two eyes affected, having through error been allowed in a cage where I kept animals not operated upon in any way, became pregnant and gave birth to three young which all had the same signs of lesion of the sympathetic as the mother, which had itself inherited the same. Dr. Brown-Séquard has observed a similar fact, which he has published last year. I add that those last animals, being put to breed with the others with deformed eyes, continued to give birth to young like themselves.

I should state here that removal of the first cervical ganglion in all cases gives results identical with those following mere section of the nerve.

In another series of experiments, which I undertook after Dr. Brown-Séquard, I obtained the same results as he did: exophthalmos in animals born of parents in which an injury to the *restiform body* had produced protrusion of the eyeball. At that time, being his assistant in his laboratory at the Paris Faculty of Medicine, I saw those phenomena, which he recently reported in the *Lancet*, continue for four generations. In those cases the animals modified by heredity had the two eyes protruding, although in the parents usually one only showed exophthalmos; the lesion in the

parents having mostly been made on one of the corpora restiformia.

Some differences, however, existed in the experiments which I made soon after those related above. For instance, I found that it made no difference whether the lesion was made on the corpora restiformia or very little below. In all cases the lesion consisted in a mere prick. Lesions of the right corpus restiforme had more power of transmission when the two parents were operated on than those of the left corpus restiforme.

The exophthalmos in these cases was produced in the animals originally operated upon both by the hyperæmic state of the soft tissues contained in the orbital cavity and an active protrusion of the eyeball; but in the offspring the soft tissues of the orbit were not hyperæmic nor hypertrophied, the eyeballs themselves were larger chiefly in their antero-posterior axis and firmer in consistency, the pupils of the eyes did not appear to be abnormal in any way. In no case did I observe any morbid change in the cornea or the lens.

I may add, incidentally, as this will lead to an attempt at the explanation of these curious facts, that in three out of five cases the section of the sympathetic nerve, or of its first ganglion on one side, produces in the brain, on the side corresponding to the lesion, a condition of unmistakable atrophy. This fact has been seen by Prof. Brown-Séquard, myself, and Prof. Vulpian.

In trying to give an explanation of the phenomena which depend upon this alteration of the intimate nutrition of the tissues of the organs under consideration, Prof. Vulpian suggests that there has probably been first a dilatation of their blood-vessels, and then, after a certain time, those vessels may have contracted, hence, the nutrition being thus less active, the atrophy followed. This hypothesis might perhaps avail to explain the atrophy of the brain, and, therefore, by analogy, of the eyes in the case of section of the sympathetic nerve, but it has the fault of being a mere hypothesis, as there is no plausible reason for admitting that a dilatation of blood-vessels, consequent upon section of their nerves, is followed by contraction; and, moreover, it does not explain the phenom-

ena in the young, nor those of the second series of experiments, where lesion of the corpora restiformia has produced exophthalmos, and still more insufficient is it in the case of the young of the latter.

I do not pretend to explain how these results were obtained in four and five generations of animals through heredity. I have made it a point to register the facts accurately, and will only submit what parallel observations in other instances of different inherited nervous lesions appear to me to warrant, and what has already been advanced by Prof. Brown-Séquard; that is, that a morbid state of the nervous system is transmitted, and not only the results of the lesions—for, surely, in the two series of experiments, the sympathetic nerves and the corpora restiformia of the young animals must have undergone *in utero*, or very soon after birth, the whole series of alterations which have preceded the final results observed in their parents after the operation, in order to have produced in them the identical phenomena. The whole argument tends to show, therefore, that in animals low in the scale compared with man the tendencies develop almost fatally into realities.

I am able, moreover, to state that I have performed autopsies on nearly all my animals, several dozen, and thus satisfied myself that there was no lesion of the sympathetic nerve nor of the corpora restiformia appreciable. There was certainly some dynamical change, however, as the results were there to bear witness.

Although not engaged in the practice of ophthalmology, I have taken the opportunity of bringing these incomplete results before this Congress, prompted by the idea that, if some analogy exist between human pathology and that of lower animals, as I believe, the difference in degree being taken into consideration, they may prove of interest.

REPORT OF THE CASE OF A PATIENT IN WHOM A FILAMENTOUS BODY WAS PRESENT IN THE ANTERIOR CHAMBER OF THE EYE.

By D. ARGYLL ROBERTSON, M.D., F.R.C.S.E.,
OPHTHALMIC SURGEON TO THE ROYAL INFIRMARY, EDINBURGH.

John Currie, thirty-nine years of age, a stone-cutter by occupation, applied to me on the 25th of September, 1874, on account of the presence of a foreign body in the cornea. On examining the eye, I readily discovered a minute particle of steel impacted in the cornea, but was surprised further to observe a hair-like body in the anterior chamber of the eye. On questioning the patient, he at once said that he was aware of its existence, and that it had been there for many years, and did not occasion him any annoyance. I was very busy at the time, and, after removing the particle of steel, merely noted down his name and address, with the view of inquiring more particularly into his case when I had leisure. The note I made was inadvertently laid aside, and I did not attempt to see the patient again until August last, when, coming across the note I had made, I sought out the patient and made the following notes of his condition :

The man is of about medium height, has brown hair, light-brown mustache and whiskers, and apparently enjoys excellent health.

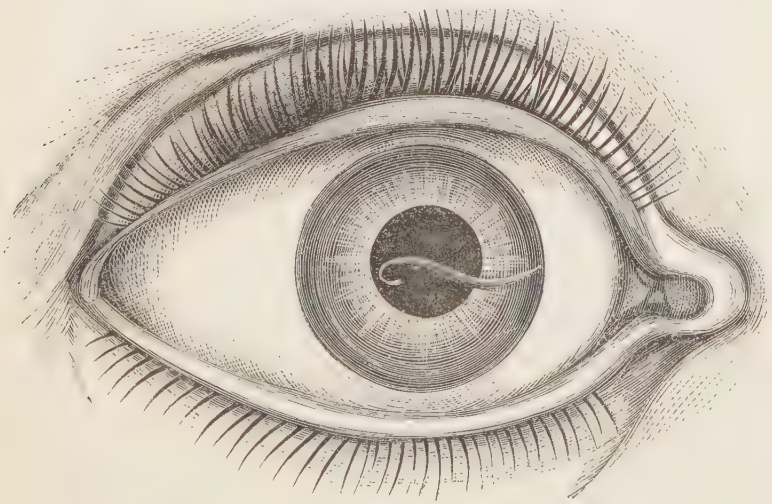
He states that above twenty years ago he first had his attention directed to the presence of a body resembling a hair in his right eye. Finding his eye irritable at that time, he asked the foreman of the works where he was engaged to look at it, as he was under the impression that there was a "fire" in the eye.[1] He was, however, referred by the foreman to a doctor, who informed him that an eyelash had got into the inside of the eye, and was occasioning the irritation. The irritation soon subsided, and the eye has never troubled him since, except once or twice on getting a "fire" into it. The only injury to the eyes he remembers suffering, prior to the discovery of the hair-like body in the eye, was when he was about ten years old, when he was struck on the eye (but he does not remember which) by a small wooden arrow, shot by a young boy from a toy bow.

He states that, when the hair-like structure was first observed, it was lying across the lower part of the iris, and that it has gradually shifted upward and stretched across the anterior chamber.

[1] At most stone, iron, or other metal works in this country, there is usually a man who considers himself proficient at the removal of foreign bodies (or "fires," as they are termed by the workmen) from the eyes of the men, and to him they usually apply whenever their eyes are in any way irritated or inflamed.

On examination, I found that vision was equally good and normal in the two eyes. Both irides were hazel-brown in color, the pupils of equal size and active.

In the *right* eye, a light-brown colored filiform body was observed with the naked eye, stretching from a point at the corneo-sclerotic junction in the horizontal plane, and at the inner margin of the cornea, across the anterior chamber, passing in a slightly curved form (the convexity downward) till it reached a very little beyond and below the centre of the cornea, when it terminated in a sharp bend like that of a shepherd's crook. It appeared to lie in contact with the inner surface of the cornea. It was thinnest at its point of attachment or origin, gradually thickened as it formed the shallow curve, tapered again toward the sharp bend, and terminated in a bulbous, free extremity. When the eye was moved rapidly upward and downward, the "lash" was set in motion, and only slowly returned to its original position. This motion was evidently somewhat impeded by the friction of the "lash" against the inner surface of the cornea, as, when the face was directed upward, and the head well thrown back, the movements of the filamentous body were much more free. The most careful examination failed to discover the slightest independent movement on the part of the "lash." Examination by oblique illumination revealed three or four minute nebulous opacities of the cornea, so fine as to be imperceptible in diffuse daylight. A very slight cloudiness was alone perceptible near the point of origin of the filamentous body.



I am indebted to my friend Dr. John Smith for an accurate representation of the affected eye.

With regard to the nature of this body, I am unable to offer any definite opinion. The length of time it has existed, the little change that has occurred in it during that time, the absence of irritation from its presence, and the non-existence of independent motion, all negative the idea of its being an entozoön.

It certainly resembles very much an eyelash in form, being thickest in the centre, and tapering gradually toward either extremity, but there is no history of such a wound as might cause the penetration of an eyelash into the anterior chamber, and no appearance of such a cicatrix as would follow an injury of this nature. The further history of the case and future investigation may, perhaps, throw light on the true nature of this peculiar body; in the mean time, I think the case of such interest and rarity as to deserve being put on record.

A CASE OF RECURRING SARCOMATOUS TUMOR OF THE ORBIT IN A CHILD, EXTIRPATED FOR THE THIRD TIME, AND ULTIMATELY CAUSING THE DEATH OF THE PATIENT.

By THOMAS HAY, M. D., of Philadelphia, Pa.

The subject of this case, a boy, H. C., not six years old, was brought to me July 10, 1874, pale and worn, with an orbital tumor of the left side projecting from the orbit upward above the supra-orbital arch, downward below the nose, and encroaching on the one side upon the nose, and on the other upon the temple and cheek.

The history of the case dates back to January, 1873, when the child was four years and four months old, at which time the first tumor appeared, growing, apparently, from the supra-orbital plate. The child had always been strong and hearty previously, and had been regarded as a healthy boy till the appearance of this neoplastic growth. He was born of healthy and strong parents; both are now living. His

brother, the only other child, is well, and no evidence of hereditary transmission of disease can be traced to either branch of the family of mother or father. The father is an inebriate.

In November, 1872, fourteen months prior to the appearance of the first growth, the child tripped on a board, and, falling, struck himself across the root of the nose upon the hearth of a cook-stove. The skin was not broken by the fall, but it caused a large transverse indentation, and a swelled and bruised appearance, which lasted a week or ten days. The accident was not attended with suffering, and no special injury could be detected. The mother, however, attributes the origin of the tumor to the effect of the fall.

The tumor grew slowly, and the child's health continued good for six months after its first appearance, when its health began to fail, and the tumor grew more rapidly, but it had caused no pain till within about three weeks before its first removal, which operation was performed by Dr. James W. Kerr, of York, Penn., in August, 1873, seven months after its first appearance. At this period the growth was not large, and, though the eyeball was somewhat displaced in a forward and downward direction, the sight was good.

The operation was performed by cutting across the upper eyelid, and extracting through the incision. The parts healed up kindly in about three weeks, and all pain had disappeared, but it was followed by complete ptosis. The boy's health improved, and it was thought he was cured. But the tumor reappeared *in loco* in November, 1873, ten months after the appearance of the first one, and three months after its removal. Its growth was more rapid than the first, and the tumor soon pressed the eyeball outward and caused it to become prominent.

In February, 1874, six months after the first operation, and three months from the date of its second appearance, it was again removed by the same gentleman, the eyeball being left *in situ* by making the incision through the cicatrix of the former one.

The growth at the time of its second removal was hardly one-third the size of the third growth (*see* photograph, Fig. 1). About a month prior to the second operation, pain in the tumor was noticed, and from that time it is supposed the sight in the eye was lost. The pain was severe, and caused loss of rest, and the child became emaciated. Touching the tumor seemed to increase the sufferer's agony, and at night he would lie on his face with his head supported by his hands to protect the eye from contact with the bedclothes. The second operation was not followed by a good result. The parts remained

swollen and painful, the tumor reappearing almost simultaneously with its removal. Taking on new growth, it increased rapidly in size, and, the patient's sufferings continuing, he became greatly reduced and emaciated. Till in May following—for three months—the pain was terrible. After that period it subsided somewhat, and in June it was very much less severe and less constant. The eyeball then having been entirely covered in by the tumor, it was no longer visible, nor could it be detected. The incision of the second operation never healed, and the edges of the wound were separated by the growing tumor, and near the inner angle a lobular mass the size of a marble protruded.

When the child came under my notice emaciation was marked, and he was restless and fretful and had very little appetite, and was evidently declining in health, although his general condition was better than it had been. He suffered much less from pain than heretofore, and to this may be attributed his improved state of health. After prescribing iron, arsenic, and cod-liver oil, I left the patient to see me again in a month. His general improvement under the treatment was decidedly marked, and his condition was so much better that I concluded to operate. The photograph (Fig. 1) is a correct and fair

Fig. 1.

picture of the appearance of the child and the tumor at the time of operating, the picture having been taken the same day. The upper black and rough surface in the picture is the site of the old incision, and the protruding mass above referred to; the one below is the palpebral aperture widely separated, nothing being visible in the latter

but an inflamed, ulcerated, and thickened membrane, from which, as well as the opening above, there is a constant discharge and oozing of thin pus. The intervening part covering the tumor is healthy but very much stretched and thinned integument.

August 10, 1874, one year and a half after the appearance of the first tumor and six months after the date of the second operation, assisted by my friend Dr. E. W. Meisenhelder, Mr. A. M. Stout, my medical student, and others who were present, with the patient thoroughly anæsthetized, I operated at York, Penn., removing the tumor and remains of the eyeball by dividing the tissues between the palpebral aperture—without enlarging the space at the outer canthus—down to the growth, and with the finger and handle of the scalpel enucleated the tumor, separating and taking away with it a large surface of periosteum from the supra-orbital plate to which it was attached in an antero-posterior direction. By compressing the mass as I gradually withdrew it, its escape was easy. Separation at the base of the orbit was made with the knife, and subsequently every particle of the morbid mass was removed. The normal tissues within the orbit were not invaded by the disease, and were perfectly healthy, the surface of the bone from which the periosteum was removed was thoroughly sound. As the tumor grew it embraced the muscles and flattened the eyeball, which latter had a position on the lower and inner side of the orbital cavity. Solid nitrate of silver was thoroughly applied, and a tampon of charpie, saturated with the solution of the persulphate of iron, was introduced and allowed to remain forty-eight hours. Very little bleeding followed the operation, and none upon the removal of the tampon. There was no suffering afterward, and, under the use of opiates, stimulants, and good diet, he speedily recovered, and two months after the operation the patient presented the appearance as represented in photograph (*see* Fig. 2). The operation was severe, and prolonged and hazardous from the effects of the anæsthetic. The anæsthetic chiefly used was one part of chloroform to three of ether by weight. From its use collapse occurred three times, and at each the operation was suspended, and I was obliged to resort to artificial means to resuscitate the patient. The third time the collapse proved almost fatal. After he revived I finished the operation, using ether as the anæsthetic. Its influence was thoroughly satisfactory, and no further delay or inconvenience followed.

For the character and minute structure of the tumor I am indebted to my friend Dr. Joseph G. Richardson, of Phila-

delphia, who made an examination of the specimen for me. I append an extract from his letter:

Fig. 2.

"Thin sections, cut from the most prominent nodule of that orbital tumor you left with me, when properly stained, exhibited large numbers of spindle-shaped, oval, and rounded cells (with moderate sized nuclei), imbedded in a well-formed fibrous stroma, which was everywhere intercellular, and separated each cell-element from its neighbors. This structure of elongated cells, isolated by an all-pervading intercellular substance, indicates, of course, that the growth is a *sarcoma fusocellulare*, and probably belongs to the group of recurrent fibroids of Paget. In regard to prognosis, since the neoplasm is positively not a carcinoma, I should give my opinion that, while liable, it is not very likely to return after thorough extirpation. Moreover, that, should recurrence take place, another, and if possible, even more radical removal of the tumor would be advisable, since we might even then hope for a complete cure."

It is but just to mention that Dr. Richardson was without the history of the case when he made the examination, and he only knew that the specimen was a tumor which had been removed from the orbital cavity of a child.

Everything progressed well with the little patient, and all his friends thought he was thoroughly cured till their anxiety and fears were aroused by the appearance of a swelling of the lower lid of the same eye, which was first noticed about three months after my operation—in November, 1874. This time the growth was alarmingly

rapid, and terribly destructive, and ended the life of the little sufferer in May, 1875, nine months after my operation, and two years and four months from the appearance of the first tumor. *Post-mortem* examination could not be had, but the accompanying photograph (*see* Fig. 3), which was taken after death and sent to me, gives a

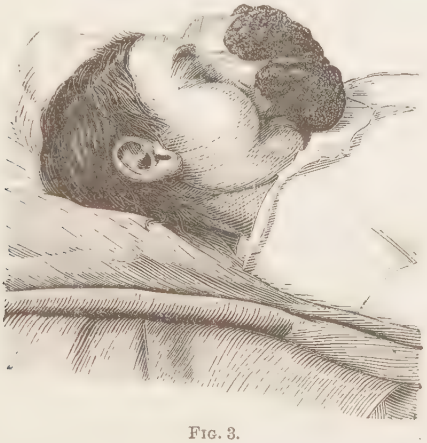


Fig. 3.

correct idea of the size of the mass and the terribly distressing condition the little sufferer must have been in. The black part of the picture shows a surface of ulcerated, bleeding, fetid fungosity.

The next paper was by Dr. Knapp.

PRESENTATION OF METRICAL OPHTHALMOSCOPE.

By H. KNAPP, of New York.

I beg leave to present to the society an ophthalmoscope, the auxiliary glasses of which are chosen according to the metrical system which has recently been recommended by Donders and met with a very favorable acceptance. The construction of the instrument is like that of the single-disk ophthalmoscope, which I described some years since. The diameters of the holes in the mirror and of the auxiliary glasses are the same, but the number of the glasses has been increased from twenty-

three to thirty-two. In the plate which covers the glasses three round openings are vertically placed one above the other. The highest is opposite the hole in the mirror and the auxiliary glass, which, at the time, is in use, the second shows the number of that glass in the inch system, and the third that number in the metrical system. The series of lenses is as follows:

0.5	dioptric	= 72″	4.	dioptric	= 9¼″
0.75	"	= 48″	4.5	"	= 8¼″
1.	"	= 36″	5.	"	= 7½″
1.5	"	= 24″	6.	"	= 6″
2.	"	= 18″	7.5	"	= 5″
2.5	"	= 15″	9.	"	= 4″
3.	"	= 12″	12.	"	= 3″
3.5	"	= 10½″	18.	"	= 2″

There are, of course, two such series, the one positive and the other negative, and the glasses are so arranged that + 0.5 is placed on the left side of the free hole and — 0.5 on the right side, the other glasses following in regular succession.

The refractive interval of $\frac{1}{48}''$ = 0.75 dioptric, which, for the weaker glasses, is usual in the majority of modern ophthalmoscopes, seemed to me too great, and I wanted to try an interval of 0.50 dioptric = $\frac{1}{72}''$. I have known, from the experience gained with my double-disk ophthalmoscope, that I have no difficulty in discriminating a refractive interval of 0.50.

Since the handling of a single-disk ophthalmoscope is more convenient than any of the double disks yet brought to my notice—the newest Paris instruments of Wecker and Landolt not excepted—I have tried to arrange, in a single disk, a series of glasses which would meet the requirements of an expert in ophthalmoscopic optometry. The main interval of the above series is 0.50, yet in the higher numbers, above 5 (dioptrics) = 7½″, the refractive interval is increased, since small refractive intervals between the stronger glasses can, in practice, be dispensed with. The disk had to be enlarged to a diameter of fifty-six millimeters (= 2″). This dimension, as experience has shown me, does not render the instrument inconvenient. I have used it with the same ease as the smaller single-disk ophthalmoscope, and employ it not for the de-

termination of refraction alone, but for all kinds of ophthalmoscopic investigation.

Its price is $30, and can be obtained from almost any instrument-maker in New York.

Dr. Noyes moved that Dr. Hansen, of Copenhagen, Prof. Becker, of Heidelberg, and Prof. Arlt, of Vienna, be appointed a committee to determine the time and place of the next Congress, and, if necessary, to appoint a provisional committee, to be taken from the city where the Congress is to be held. Seconded and carried.

The PRESIDENT: If there is no further business, I wish to say one word before closing the proceedings, and that is that I have felt very highly complimented at being selected as your chairman, and I feel exceedingly gratified and thankful for the polite attention and coöperation which you have uniformly given to the meetings during our interesting sessions; and I shall never forget the pleasant associations by which we have been surrounded. I thank you again most heartily for the honor that you have conferred upon me, and for your kind consideration and forbearance.

Mr. CARTER, being called upon, said:

Mr. President and Gentlemen: A plain farmer was once called upon to make a speech, after an address by one of our greatest English orators. He came forward, and said: "Gentlemen, I say ditto to Mr. Burke." (Laughter and applause.)

The PRESIDENT: The Congress stands adjourned four years.

In the evening the foreign delegates were entertained at a banquet at Delmonico's, by the American Ophthalmological Society. About one hundred guests were present, a number of toasts were drunk, and remarks were made by Prof. C. R. Agnew, President of the American Ophthalmological Society, Prof. E. Williams, President of the Congress, Dr. D. Argyll Robertson, of Edinburgh, Prof. H. W. Williams, of Boston, and others.

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